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ENORMOUS TROLLEY EARNINGS.

At the beginning of the present year we made for 1906 our usual estimate of output and earnings in the various departments of electrical activity, the data appearing in the issue of Jan. 5. At that time we gave the probable street railway earnings as not less than $360,000,000, a sum that looked very large and was criticized by some as being excessive and inaccurate. It is interesting, therefore, to note the figures given in the "Red Book," a standard annual compilation of data on street railway properties issued by the McGraw Publishing Company in connection with the *Street Railway Journal*. The "Red Book" makes a classification of earnings in five large classes, including 481 systems, and embracing practically every earner of any capacity, although all told there are not far short of 1000 such roads or systems in the country. It appears that 63 systems reported earnings of $275,245,206, and that the whole 481 reported $358,043,073. This is, as will be noted, barely two million short of our estimate or "guess"; and allowing for some duplication offset by the roads not reporting, the figure of $360,000,000 may safely be accepted, as confirmed in an extraordinary manner by these official reports summarized six months later.

We are glad to note the accuracy of our forecast, and gratified also with this splendid evidence of the ability of electricity to create great industries and solve the problems of urban transportation. In 1890, when the street railways were still very largely under a régime of horse and cable, their total income from all sources was $91,721,845. In 1902, when a considerable proportion had been converted to electrical methods, the gross income was $250,504,627, or just about $100,000,000 less than it was four years later. Thus the earnings have been growing at a compound rate of almost exactly 10 per cent yearly. To maintain such a growth would seem difficult, but there is no reason to believe that the year 1907 will show any falling away under the régime of complete electrification.

A LITTLE LESSON FROM ITALY.

We Americans were in bygone years accustomed to lead the vanguard of improvement, and used to show the way to the world in many a line of technical advance. It is therefore something of a shock to the consistent Chauvinist to find the technical progress now in no small measure in the hands of others. Has Yankee ingenuity lost its grip and Yankee hustle its motive power? We think not, but yet the situation is not gratifying to natural pride. It is not easy to analyze its causes, but the fact seems to be that many an improvement is neglected here long after it is put to good use abroad, even though it be actually of American origin. Whatever the explanation, it is a bit annoying to the patriotic engineer to see the Italian Government pushing ahead with the electrification of its State Rail-

ways, while here each trunk line waits for another to move first. We believe that one of the stock arguments against governmental ownership of railways is the difficulty of getting improvements made when competition is abolished! Italy, however, has been singularly wide awake in electrical matters ever since the days of Alessandro Volta, and it is perhaps fitting that Italy should show us the way in this.

It is not a large program from the standpoint of our merger kings, this electrification of about 200 miles of line in a dozen sections, but it shows a willingness to go ahead and a faith in the future of electric traction that are most commendable. Italy is not a rich kingdom and $10,000,000 looks larger there than here. It has been appropriated, though, while we here have been thinking the subject over and the work will go ahead. The work is to be mainly on the three-phase system as used in the Simplon tunnel and on the Valtellina line. In cases where a direct current line is already running the extensions are naturally on the same system. By and large, however, three-phase traction seems to be successful on the other side of the water, while here the only recognition it has thus far received is in the plans for the electrification of the Great Northern Cascade tunnel. The Italians in particular are showing enterprise that quite puts us to shame. They have met sufficient success to justify them in going ahead without waiting for an ideal system to become standardized. Considering the mileage of railroads in Italy, about four per cent only of our own, a very good beginning has been made. American progress in electric railroading has been great in independent lines, without having gone much into the electrification of ordinary railroads. We would not in the least belittle what has been done here in electric traction. Its weak point is that it has of late, with a few notable exceptions, fallen into growth along conventional lines, while foreign engineers have pushed ahead with some very valuable and suggestive pioneering which we seem slow to follow. Even in high-voltage direct current working, of which some competent engineers think very highly, the advances have been wholly abroad, and in alternating-current traction we can as yet show comparatively few results. It is time to wake up.

Track Resistance with Alternating Current.

In an interesting paper noted in the Digest, Herr Lichtenstein takes up rather exhaustively the increase in track resistance found with alternating current, a subject just now of growing importance. The subject has been studied to some extent by others, but we know of nothing so exhaustive or carried out under more nearly practical conditions than this. Of course the increase in virtual resistance is due to a combination of causes, the saving factor being the low value of μ found at the current densities used. Herr Lichtenstein pays especial attention to the computation of this from the experimental data and finds values of μ ranging from 8 to 20 under the various circumstances of use. The impedance factors found, for the Zorsen Marienfelde track, by the way, varied from 2.65 at about 18 cycles and about 36 amperes in the rail, to 6.3 at, nearly, 50 cycles and 150 amperes. It is perfectly clear that low current density and periodicity are necessary if this factor is to be kept within any reasonable limits. Even so the results would be had were it not for the very bad (for general purposes) magnetic properties of modern rail steel. If the rails were at all comparable magnetically to ordinary steels the permeability would be several times that observed and the inductive effects correspondingly worse. Evidently in using alternating current for railway purposes it is going to be advisable to keep the voltage as high as may be to decrease the current density in the track, as well as for the usual reasons. One must be prepared, clearly, for impedance factors at three or thereabouts even under fairly favorable conditions. As to periodicity from this point of view, the lower the better. We hope that when the New York, New Haven & Hartford electric system goes into service the same interesting question may be worked out on its tracks with the perhaps even less magnetizable American steels.

Balancers versus Three-Wire Dynamos.

The paper by Mr. Budd Frankenfeld on this topic discussed at the Washington convention of the National Electric Light Association, and printed elsewhere in abstract, presents a good contrast and comparison between the balancer and the three-wire dynamo. It also gives a good condensed history of the development of three-wire dynamos, which are very rare in large central stations, although they are common enough in isolated plants. The argument is made that balancer sets should be rated on the basis of neutral current supplied, and of half the main outside voltage. This is tantamount to rating a balancer as a motor-generator, and according to the output of the generator element. Thus, a balancer which worked across 220-volt outside mains and delivered 500 amperes at rated load would be a 110 x 500 or 55,000 watt machine. The summing up is powerfully in favor of the balancer for central station three-wire distribution. The advantages of the balancer over the double-unit generator system are indeed remarkable, and it is strange that the balancer has not come more generally into use in this country. In Europe, the balancer is more generally used in three-wire central-station distribution than it is with us. The only marked advantage of the double-unit generator over the single unit and balancer system is in the voltage to which the arrangement can be advantageously carried; but since the United States central station Edison voltage is nearly always limited to 250 volts between outers, this consideration is of no consequence.

The Purity of Vibration Frequencies in the Lines of the Visible Spectrum.

In the last number of the *Bulletin of the Bureau of Standards*, a paper appears on the purity and intensity of monochromatic light sources. Among other subjects considered are questions as to the sharpness of the spectrum lines—or what corresponds to the same idea—the purity of the frequencies of vibration which such lines represent. In a well adjusted spectrometer, the lines in the visible spectrum appear marvellously sharp and thin, representing what appears to be a high degree of purity and precision in the corresponding atomic vibration. A single rate of vibration would be represented by an indefinitely thin line in the spectrum of a perfectly adjusted spectroscope. The lines possess, however, a small but appreciable breadth. The breadth is partly to be attributed to the imperfections of the

optical apparatus. The remainder is, however, a real want of purity in the vibrations examined. It may mean that different electrons are oscillating slightly out of synchronism in different atomic systems under examination. Possibly the mutual jostling of colliding atoms tends to accelerate some electrons temporarily, while at the same time retarding others. Consequently the rates of oscillation deviate slightly on both sides of the normal or mean frequency. In estimating the purity of a spectrum line, the article proposes to use in the case of a pure doublet the ratio of the distance between the two components to the length of the wave. It is shown that the degree of purity of the spectrum lines varies between about one part in a thousand for the broadest lines, to about one part in four million for the narrowest lines. The subatomic alternators in the latter case maintain synchronism within such a degree of precision. It is pointed out, moreover, that some of the fainter satellite lines in the immediate vicinity of main lines have a yet higher sharpness and degree of purity.

THE POWER FACTOR OF RUBBER-COVERED WIRES.

There is hardly any subject on which electrical engineers dispute so readily, and differ so radically, as rubber-covered cables. Experiences have been very varied with rubber cables, and the subject is very complex, both from the chemical and the physical point of view. Some declare that all that is needed to make a high-tension rubber-insulated cable successful is to have 30 per cent pure Para gum in the insulator and allow the manufacturer to satisfy his own bent on the remaining 70 per cent. Others declare that provided only there is 30 per cent of rubber in the insulation, it does not matter whether it is 20 per cent or 10 per cent pure gum; second-hand redigested rubber will do as well. Each advocate cites actual experience in support of his views. A paper read by Mr. Henry W. Fisher recently, before the American Institute of Electrical Engineers, described a number of tests on different samples of rubber-covered No. 10 wire. The break-down voltages of 17 samples of different manufacture varied between 12.8 kilovolts and 23.1 kilovolts with an average of 18.5, the latter representing a maximum electric stress near the wire of 21.3 alternating kilovolts per millimeter. Comparing the observed breakdown stresses with the chemical analysis of the different samples, there seems to be very little interconnection, except that the samples containing most rubber usually had higher electric strength. The percentage of rubber by analysis is indicated as having varied between 15 per cent and 28 per cent. Taken as a whole, the conclusions that the paper leads to, seem to be that nothing can be predicted about the electrical behavior of rubber-covered wires on the market from chemical analysis, within the range of samples in commercial use. High-grade samples and low-grade samples often seem to test much alike.

The method employed in testing the power-factor was of comparatively recent development, and deserves to be more generally known. It depends upon the use of a "vibration-galvanometer." This consists essentially of a fine wire set in a magnetic field and carrying the testing current. The period of oscillation of the wire is adjusted mechanically, so as to be in resonance with the fundamental frequency of the testing alternating current. The galvanometer is then placed in a Wheatstone bridge arrangement for measuring the capacity of the cable under test. Until recently, it had been customary to attempt a Wheatstone bridge balance in a capacity test of this kind, with a telephone in place of a galvanometer. Owing to the various harmonics present, the telephone never could be brought to silence, and a minimum of sound was almost impossible of determination. With the vibration-galvanometer, however, adjusted to vibrate powerfully at the single fundamental frequency, and only very feebly at other frequencies, this difficulty is overcome, and the paper describes the sensitiveness of the arrangement as such that capacities of suitable magnitude can be measured to one part in 5000. The frequency of the alternator must, however, be carefully controlled, and in the cases reported was governed by an electrically vibrated tuning fork, the most uniform source of controlled frequency known.

The observed power-factors of the various samples reported varied between 2 per cent and 9 per cent. This represents a very marked difference between the different samples. The power-factor of a cable is the ratio of the watts, expended mainly in the dielectric, to the volt-amperes of the charging current. The power-factor is usually regarded as fairly constant at different voltages. It is a very important quantity, from an engineering standpoint, because it represents waste of power, like that in the iron cores of transformers, going on day and night, if the alternating-current cables are kept charged. In the case of the tests reported, the power wasted was only from 1 to 10 watts per 50 miles of wire, at 53.5 cycles per second. If, however, the testing voltage had been 7500 volts, instead of 75 volts, or 100 times higher, the power wasted would probably have increased as the square, or would have been 10 to 100 kilowatts per 50 miles of wire, with an average of, perhaps, one kilowatt per mile. In the case of direct-current systems of distribution, practically all the power wasted in transmission is by I^2R in heating the wire. The same is substantially true for low-tension alternating-current distributing cable systems, or for high-tension alternating-current distributing overhead bare-ware systems; but with alternating-current cables, operating at from six to ten kilovolts, or more, the waste of power is partly in the conductor and partly in the insulator. The tests reported in the paper seem to indicate that the larger the proportion of rubber in the insulator, the lower the power-factor, and, therefore, the lower the waste of power. This rule, however, does not apply to all of the results. In particular cases, a lesser rubber content was accompanied by a lesser power factor. The importance of the power-factor of a cable is not only in the loss of power in the dielectric. It is also important because the greater the power wasted in the dielectric, the higher its temperature, and the greater the depreciation of insulation and dielectric strength. That is, a large power-factor not only costs power and eats into the coal pile when a large system of high-tension underground cables has to be fed; but it also heats the cables unduly, and tends thereby to lower their dielectric strength. The tests indicate that the whole subject is most complex, but that from a practical standpoint the power-factor of a cable is nearly as important to the purchaser as the dielectric strength. These two quantities do not appear to be very closely connected, except that in a general way the samples that were weakest in rubber were weakest in strength and largest in power-factor, with puzzling exceptions to both these rules.

Boston Street Lighting Report.

Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology, Mr. Samuel H. Hudson, of Boston, and Mr. Herbert A. Wagner, consulting engineer, of New York, have submitted to the city of Boston and the Edison Electric Illuminating Company of that city a report upon the cost of street lighting in Boston in their capacity as an arbitration board between the city and the Boston Edison Company. The work of these experts as arbitrators was to determine:

1. The proportion of the actual output of electricity generated at the Edison Company's stations for the public lamps provided for in the street lighting contract as compared with the company's entire output in kw-hours.

2. The total investment of the company in land, buildings, plant, poles, lines, conduits, cables, meters, machinery, apparatus and other equipment used in the manufacture and distribution of electricity.

3. The investment of the company on account of its public business obtained by taking the proportion of the total investment that the output on behalf of the public lamps bears to the total output, unless the arbitrators unanimously select a better method.

4. The total operating expenses of the company, meaning the annual outlay for fuel, water, supplies, wages, salaries, insurance, accidents, rents, taxes and all other expenses except depreciation in excess of ordinary repairs.

5. The operating expenses of the company on behalf of public lamps, computed by taking the proportion of the total operating expenses of the company that the electrical output for street lamps bears to the total output.

6. The undivided or surplus earnings of the company, being its gross annual income derived from the sale of electricity less operating expenses, dividends and interest; and the percentage which the company's annual surplus bears to the total investment, exclusive of land.

7. An allowance for depreciation in excess of ordinary repairs of the company's investment in plant and property used in its public business, computed by taking the same percentage of the value of the company's investment on account of its public business as in (3), but excluding the land, as the total amount of the undivided earnings of the company (6) is of the company's total investment (2) exclusive of land; such allowance not to exceed 7 per cent of the company's investment on account of public business exclusive of land.

8. An allowance for interest or profits computed at 6 per cent per annum on the company's investment on account of its public business (3); but in case the cost of any part of the company's investment shall have been met by the issue of bonds bearing interest at less than 6 per cent, and any of such bonds are still outstanding, the amount thereof shall be apportioned between the company's total investment and its investment on account of public business in proportion of the electrical output as in (1); and the allowance provided for in this clause shall be computed on so much of the company's investment on account of public business as is represented by such bonds at the rate actually paid upon them, and on the remainder of its investment at 6 per cent per annum.

The contract finally provides that in case the cost of manufacturing and distributing the energy for public lighting and the allowances for depreciation and profit (5), (7) and (8) amount in the aggregate to a sum less than the price then being paid by the city, the price of lighting shall be reduced for the remainder of the term of the contract, or until again reduced by arbitration to a sum equal to the cost of manufacture and distribution, plus the foregoing allowances for depreciation and profit.

The arbitrators compared the operations of the company for the fiscal years ending June 30, 1904, 1905 and 1906. The returns for 1906 were found to give the lowest cost to the city and as this year immediately precedes that upon which the arbitration takes effect, it was agreed upon as a fair basis for award. The methods of procedure prescribed and applied to the 1906 returns gave a cost to the city which exceeded the amount paid by the city to the company during the same period by $45,700. The arbitrators unanimously agreed that the maximum demand method used by the company in its commercial rates would be more fair and equitable under present conditions to determine the proportional investment on account of public business than the kw-hour pro-rating method. Therefore a new determination of the investment on account of public lighting was made by applying to the total investment of the company the ratio which the maximum demand upon all the stations of the company by the public lighting bore to the total demand upon the company at the peak load in December, 1905. This reduced the figures obtained by the straight kw-hour method by $63,000, making a saving to the city of $17,300 per year compared with what it paid in 1906, or a total saving to the city in 2.5 years, of $43,250. About 1,850,000 kw-hours was used to operate apparatus directly in the company's main generating station upon which the generation of energy for both public and commercial lighting is dependent, and it was considered that this portion of the energy generated was not properly nor actually a part of the output. The arbitrators found it difficult to determine the exact or fair amount of this energy to be deducted, and unanimously agreed not to make the deduction, which decision results in an advantage to the city of $5,000, which is included in the $17,300 reduction previously referred to.

The price to be paid by the city for the last 2.5 years of the contract is therefore to be reduced in the proportion that $17,300 bears to the $377,075 paid by the city for the fiscal year ending June 30,1906, or at the rate of 4.6 per cent on all bills rendered at the contract rates for service after Aug. 20, 1906 to the end of the contract. The company is to refund to the city 4.6 per cent of all amounts so far paid to it by the city for public lighting service rendered from Aug. 20, 1906 to July 1, 1907, with interest at the rate of 6 per cent per annum on such refunds.

The arbitrators visited the company's power plants and found the great proportion of its equipment representative of the highest economy in steam and electrical engineering.

Convention of the National Electrical Contractors' Association.

The National Electrical Contractors' Association began its seventh annual convention at the Engineering Societies Building, New York City, on July 17, and the meeting was in progress at the time of our going to press.

The programme as arranged is as follows: The first session, which was open to everyone interested in the electrical business, was called to order at 10 a. m., July 17, by Mr. J. C. Hatzel, chairman of the National committee, who introduced Mr. James Hilton, president of the Electrical Contractors' Association of New York State. Mr. Hilton welcomed the members and guests on behalf of the State Association, and turned the convention over to Mr. James R. Strong, president of the National Association. Mrs. J. B. Olson, on behalf of the ladies' auxiliary of the Association presented Mr. Strong with a handsome bouquet of roses. The work for the rest of the morning is as follows: Professor George F. Sever, consulting engineer of the City of New York, will address the convention on the relations between the municipality and the electrical contractor. Mr. Arthur Williams, past president of the National Electric Light Association, will speak on the relations of the lighting company and the contractor, and will be followed by Mr. J. Robt. Crouse, who will explain the work of the Cooperative Electrical Development Association during the past year. This will terminate the morning session, and in the afternoon there will be a business meeting.

At 10 a. m. on July 18, there will be another open meeting, and addresses will be made as follows: Mr. Hugh T. Wreaks,

secretary of the Wire Inspection Bureau, will discuss the "Standardization of Wire." Mr. T. C. Martin, of the ELECTRICAL WORLD, on the relations between the press and the electrical contractor. Mr. C. M. Goddard, secretary of the Underwriters' National Electrical Association, will speak on the relations between the underwriter and the contractor. Mr. C. L. Eidlitz, first president of the National Association, will speak on the subject of that body. Mr. Oscar T. Crosby will describe the Cahill telharmonium, and the convention in a body will visit the plant at the close of the morning session. The remaining sessions will be occupied with executive business. On Wednesday, July 17, there will be a river trip for the ladies in the afternoon, and in the evening there will be a dinner at the Waldorf, followed by an amateur vaudeville by members. On Thursday, there will be an automobile ride for ladies in the afternoon to Coney Island, and in the evening, for members, a smoker at Shanley's, after the business session. On Friday there will be a trip up Long Island Sound by boat, with clam bake and baseball game, East against West, by members.

In the Early Days.

A "Retired Manager" becomes reminiscent as follows in *Stone & Webster Public Service Journal*, the occasion being a visit to his former headquarters, where he reports that a resolution aimed at the company had been introduced in the council the evening before:

"The Billville Electric Company don't seem buried under popularity of late, Jim. And you think the company is giving better service than ever?—Well, as to the latter, I agree with you. Yes, sir; I agree with you. Why, in my day it was an even bet that the lights went out three times between soup and nuts. In those days we ran the Opera House lights off the railway circuit, and every car that came up Sixth street grade produced Stygian blackness in the Opera House. We had a flagman to hold the cars at critical points in the play, but even at that, Eliza often crossed the Ohio without a glimpse of the ice. Well, I suppose I can't better describe the kind of lighting service we used to furnish than by saying that the gas people actually pitied us. While our lights were some bad, our railway work was certainly the limit. The principal duty of the superintendent was to see that every man returned his car before he went home, and to take care of the money that was crowded on him. Nobody rode in the cars except careless people who set no value on their time. I remember that we once tried an innovation and washed the windows of a car. Old Dr. Griswold was misled by the result and ruined his new silk hat by forcing it through the window under the impression that it was open. We had to buy him a new hat, and that stopped any further improvements.

"Yes, Jim; you do give better service; in fact, you are doing an entirely different business. Your business has now developed until it is a science, that is, the administrative department has, but I can't see that there has been much of a change in the 'diplomatic' department so to speak. This end of the business has stopped right where it was years ago in your case, and you have got more company than a flea on a dog. Did you ever think of the natural advantages we had in those days when we desired to swat a patron who thought he knew how to run our business? To begin, John Swazy and I owned most of the stock; I was president and manager and John was treasurer. John knew more folks in this country than any other living man, excepting, possibly, myself, and he knew 'em well enough to eat in the kitchen with the family, and have everybody call him by his Christian name. As to our men, 'employees' you call them, why they were our neighbors. That's the kind of a line-up we had in those days. There were no rules, and they wouldn't have been obeyed had there been any—and a passenger who got 'flossy' with a conductor settled it with the conductor. A man who complained about his lights was told that he knew what he could do about it by a man who rented him his house, or to whom he owed poker money. As to the city officials, they most all owed John money, and those who didn't thought an electric franchise was a joke on the fellow that got it. Then again, society in this town had not reached that stage where it began to think in large chunks. So far as its relations with our company were concerned, its reflections were individual or personal. If one of our men 'sassed' anybody the franchise of the company was not hit in the solar plexus; simply the schedule was interfered with during the adjournment behind some neighboring barn to arbitrate the matter."

Fifteen-Cycle, Single-Phase, Demonstration Locomotive for the Pennsylvania Railroad.

On page 91 of our issue for July 13 appeared abstract of a paper by Mr. N. W. Storer containing a brief description of an 11,000-volt, 15-cycle, single-phase locomotive built by the Westinghouse Electric & Manufacturing Company for the Pennsylvania Railroad. We are now able to report the results of tests of this locomotive and to explain more fully the service for which it was designed.

The locomotive has been developed by the Westinghouse interests in conjunction with the Pennsylvania Railroad, under Mr. George Gibbs, chief engineer of electric traction, according to the programme laid out by the late President Cassatt, and is the third locomotive built under that arrangement. The first locomotive, which was designated as No. 10,001, was of the geared, direct-current type. The second, known as 10,002, was of the gearless, direct-current type. Both of these locomotives were placed in service on the Atlantic Avenue improvement of the Long Island Railroad; each is driven by four 350-hp motors and weighs about 100 tons. The mechanical parts of these two locomotives were constructed at the Altoona shops

SINGLE-PHASE, 10,000-VOLT, 15-CYCLE, LOCOMOTIVE.

of the Pennsylvania Railroad, but the electrical equipment was supplied by the Westinghouse Company.

Locomotive No. 10,003, which is illustrated herewith, has been produced as a result of a systematic investigation involving elaborate tests that have been prosecuted for several years. On account of the limited time available, and the necessity for the elimination of all possible delays, both the mechanical and the electrical parts were supplied by the Westinghouse interests. Its design is such as to render it especially suited for the severe service in connection with the New York terminal operation of the Pennsylvania Railroad. The duty required will be appreciated when it is known that grades of 2 per cent are encountered, and yet high speeds must be attained. On the test tracks at Pittsburg, which are about five miles long, and in reality a succession of curves, locomotive No. 10,003 recently reached a speed of 73 m. p. h., and it is claimed that a speed of 90 m. p. h. can easily be reached on a straight track.

The complete locomotive is to consist of two separate halves, only one of which has yet been constructed; the half locomotive

has been found to exert a maximum draw-bar pull of 24,000 lbs., indicating a tractive effort for the whole locomotive of 48,000 lbs. The former locomotives were built for third-rail, direct-current operation, while the latter locomotive will use single-phase current from an overhead trolley wire. Before the construction for the electrification of the Pennsylvania terminal in New York is undertaken, it is the purpose of the Pennsylvania Railroad thoroughly to test out the merits of these two systems. The decision will probably not be reached before Jan. 1, 1908.

The most striking features of locomotive No. 10,003 are its entire simplicity and the accessibility of the parts that may require attention. All of the main control equipment is placed on a raised platform in the middle of the cab on each side of which there is a wide passageway. The voltage regulating switches are arranged immediately above the main 11,000-volt auto-transformer, while the blower equipment and reverse switches are placed immediately over the propelling motors. Ample space is left on all sides of the main motors for inspection and repair.

The motors are of the gearless type, the method of mounting being identical with that used on the New Haven locomotives, as described in our issue for April 14, 1906.

It is interesting in this connection to note that the Westinghouse Company has already built, or has under construction, 60 single-phase locomotives and more than 2000 single-phase compensated series railway motors, and that at the present time at least 1000 miles of track have been arranged for single-phase operation.

80,000-Station German Telephone Exchange.

The new telephone exchange of Hamburg, Germany, is designed for service to 80,000 subscribers. The operating room for local connections is 433 ft. long, 65.6 ft. wide and 32.8 ft. high, with double skylights. Below is the apparatus room with the distributing frames, relays, motors, etc., 433 ft. long, 65.6 ft. wide and 10.5 ft. high. The cable shaft from the street, which terminates in this room, is 46 ft. wide and 8.2 ft. high. In an adjacent room of the same floor the battery is located and below it is the operating room for trunk connections, 131.2 ft. long, 65.6 ft. wide and 26.2 ft. high. The exchange has an ultimate capacity for 80,000 subscribers, but at present will be fitted up for 40,000 subscribers.

The system used is the so-called "Verteiter" (distributing) system, by means of which through subdivision into a "distributing" and "connection" exchange not only quicker connections are possible, but there is a considerable saving in operators, cables, jacks, etc.

The exchange consists of three groups. In the "distributing exchange" the incoming cells are distributed to the operators of the "calling exchange" who forward the desired connection to the non-occupied operators of the "connection exchange," where the multiple jacks are divided in groups of 10,000. For the 40,000 lines there are 1,000,000 jacks, 66,000 lamps, 98,000 relays, 12,500 plugs, 22,000 keys and 279.5 miles inside cables.

The advantages of this "distributing system" are even distribution of all incoming calls to the operators, avoiding a crowding of calls to operators already busy, and by means of this a more rapid connection between two subscribers. The trunk exchange has 500 trunk lines. At present there will be installed 70 switchboard sections, each with two operators, 24 distributing tables and four information desks. When a subscriber asks for information the operator writes a note on a slip of paper which is sent by a pneumatic tube to an information desk. Any desired information is given by the information desks. For night connections special trunk boards are provided.

The power plant consists of two storage batteries, each of 15 cells, one as a reserve, and the necessary charging machinery. All protective devices for relays, lamp circuits, etc., are placed in one room.

Expert Investigations in Municipal Ownership.—I.

A general review has been issued of the examinations made in the United States of municipal and private plants by the Municipal Ownership Commission of the National Civic Federation. This review is by a committee of four appointed by the commission. Two of the writers, Messrs. Walton Clark, vice-president of the United Gas Improvement Company, of Philadelphia, and Charles L. Edgar, president of the Edison Electric & Illuminating Company of Boston, criticize severely the municipal plants examined, while two other writers, Prof. Frank Parsons, of Boston, president of the National Public Ownership League, and Edward W. Bemis, superintendent of the Cleveland (Ohio) water works, find much to favor in municipal plants which were investigated. Several reviews of British municipalization will be made public later. Messrs. Clark and Edgar concur in the statement that the inquiry of the committee, both from the standpoint of British and American experience, more especially the latter, has shown that "where municipal ownership has been removed from the realm of philosophic discussion and put to the test of actual experience it has failed ingloriously." The belief is expressed by these gentlemen that the "few enthusiasts" who still advocate municipal ownership "will soon be convinced by the logic of events, and turning their energies to other things will through them realize their ambitions of usefulness to their fellows." Prof. Parsons and Mr. Bemis, on the other hand, take a most hopeful view as to municipalization, declaring that the failures of municipal ownership are insignificant compared to the failures of private ownership, either in number or importance. "It is not public ownership, but private ownership," Prof. Parsons says, "that is responsible for our periodic crises and the ruin of our industries." As to the fitness of American cities to manage business affairs, many of them, he says, have clearly proved their fitness, and the rest can be made fit. "It is not impossible," he adds, "that the elimination of the public service corporations through public ownership is one of the things that would do more to help along the process of making our cities fit." Mr. Bemis believes that the greatest reason for the strength of the municipal ownership movement lies in the relations of the public service corporations with the state and local governments, which relations he declares are destructive of political purity, democracy and free institutions. In this same connection Mr. Edgar and Mr. Clark take the view that the evil of building up political machines with city employees as a basis exists now to a degree in American municipalities and that the disastrous effects would be much greater if the many gas, electrical and street railway employees were added to the present number of city officeholders.

The reports reviewed by Messrs. Clark and Edgar, on the one side, and Messrs. Parsons and Bemis, on the other, aggregate almost one million words and were made to the Public Ownership Commission of the National Civic Federation by technical experts, engineers, accountants and statisticians who visited a large number of public and private enterprises in the United States and Great Britain.

Mr. Edgar and Mr. Clark agree in setting forth numerous objections to municipalization, a very important one being that in several British cities which have tried public ownership, it has been found that the organization of municipal workmen constitutes a serious threat against the municipality itself and as a result the disfranchisement of city employees is being seriously considered in England. Were municipal employees in this country to organize, under extended city control of public utilities, the writers declare the remaining voters would find themselves beneath "a tyranny of democracy which is no less galling to the individual oppressed and no less detrimental to the welfare of the state than is the tyranny of a despot." The remedy proposed in England, disfranchisement, is declared to be "unthinkable" in the United States. Under public ownership of public utilities, it is declared those in control of the

government are submitted to continuous temptations; first through the opportunity to build up a political machine, with the city employee as a basis, and second, through the opportunity to unduly favor contractors, with the expectation of either financial or political benefit to themselves.

"There is little about municipal trading to attract men of the first class." Mr. Edgar and Mr. Clark unite in saying: "We have not found evidence in the United States that the personnel of the city government of Chicago (referring to Mayor Dunne's administration) or Wheeling is superior to that of Atlanta or Norfolk, or that the introduction of municipal water and electric plants in Detroit has brought a higher type of citizenship into the governing body than we find in New Haven, which has neither."

Three American gas plants were examined by the Investigating Committee and experts. These were at Wheeling, where the plant is operated by the city, and Atlanta and Norfolk, where there is private ownership and operation. In addition the committee visited the Philadelphia gas works and the labor investigators visited the Richmond, Va., gas works. As to the price charged the consumers, it was found to be 75 cents per thousand cu. ft. net at Wheeling, $1 net at Atlanta and $1 net at Norfolk, the municipal plant thus selling at the lowest price. To offset this, however, Messrs. Edgar and Clark point out that in Atlanta there is free installation of service, at Norfolk partially free installation, while at Wheeling charge is made for the service pipe from the curb to the meter and for the setting of the meter.

In comparing the public and private gas service, the reviewers say: "If we consider together the price the Wheeling consumer pays for gas and the character of the service rendered, we may not doubt that he gets less of net results per dollar expended than does the gas consumer in Atlanta or Norfolk. Low and varying pressure, uncertain candle-power, influenced at times by a dash of natural gas (at Wheeling) will bring troubles to studying children, that, while not factors in financial calculations, have a proper place in this inquiry. Wheeling's gas plant is not an important factor in the well-being of Wheeling's citizens. What with fast meters, charges for service and meter setting, absence of any gratuitous work, the admixture of 15-cent, 8-cp natural gas, insufficient and irregular pressure, and general inefficiency in the complaint department, Wheeling gas is a dear commodity at any price. Our experts found nothing to praise in Wheeling's service and little to criticize in the service of the companies at Norfolk and Atlanta. In general, it may be said, so far as condition of plant and operating efficiency is concerned, there could not well be a worse condition of affairs than the engineers report as existing at Wheeling. In the other two cities the record regarding condition of plant, and regarding the various points of practice mentioned above in the case of Wheeling, while it contains a few points of criticism, is on the whole satisfactory. In both cases the plant is pronounced to be modern and kept in an orderly condition."

The labor situation at the plants examined is compared to the advantage of the private plants. "The general impression made at Wheeling," says Messrs. Edgar and Clark, "was that no one about the works took any more interest in his duties than was absolutely necessary to enable him to hold his job, and no one, either at the works or on the street, was at all interested in getting work done in an efficient manner. The power of appointment at Wheeling did not rest with the superintendent, and therefore the employees did not have the fear of discharge by him in case they did not perform their work properly. At Norfolk and Atlanta the certainty of prompt discharge in case they did not satisfy their immediate superiors in the operation of the plant acted to make the men work better and more efficiently than was the case at Wheeling."

Referring to the Philadelphia gas works as an instructive comparison of the results of municipal and private operation, the reviewers quote Dr. L. S. Rowe as authority for the statement that the quality of the gas supplied has been improved by the company now operating the service, and that through the rental paid the city has received for eight years an average profit of $491,674 annually, while for the last few years under city operation there was a loss of $245,398 per year. The private company, however, charges no more than did the city, but supplies better gas. "The commission's records," say Mr. Edgar and Mr. Clark, "indicate a high degree of efficiency in the company operation of the Philadelphia gas works, and kindly and liberal treatment of employees. On these latter points Dr. Rowe speaks as follows: 'As has been shown (under municipal management), there were abuses in almost every branch of the operation. The purchase of coal and the residual products were each under the control of favored individuals; the wages account was padded with incompetents, the friends of men prominent in city politics. It is unquestioned that there were leaks in the management of the gas works at other points than the distributing system; it is true that the labor account was debauched, and it is certain that in the purchase and sales departments there were influences at work which worked harm to the city's interest. But the loss through such sources was inconsiderable when compared with those inflicted by councils by the senseless blocking of the way to improvement in cutting off the appropriations for modernizing the plant. During the entire period of municipal operation the officers in charge were engaged in a losing fight to preserve the works from ruin. There never was a time during the entire period of responsible control when it could truly be said that the works were in an efficient condition.'"

Four of the best known American municipal electric plants, those of Chicago, Detroit, South Norwalk, Conn., and Allegheny, Pa., were examined by the commission and the experts. Of these South Norwalk is the only one that does commercial lighting. As to the cost of operation of these plants, the Chicago plant is cited to show that including items of depreciation, interest, taxes, proportion of salary, insurance and water, there is a loss to the city, based on simple interest on the amount paid, of $6.70 per lamp per year, or a total of $284,202 annually, compared with what the cost would be if service were taken from a private company. Computed with compound interest on the amount paid, the loss is $11.07 per lamp, or $469,217 per year. These figures are based on statements submitted by the commission's expert accountants and do not agree with the estimates of the City Electric Department, which show a saving to the city. As to the character of the plants, that in South Norwalk is criticized for its use of a direct-current, 220-volt two-wire system, a type never generally adopted in this country. This equipment, say Mr. Edgar and Mr. Clark, compels the consumer in South Norwalk to pay 20 per cent more for the light produced than would be necessary under a better system. The Detroit electric undertaking is found to be of a type of about 15 years ago and the capacity can hardly be expanded within the present building unless the type of operating units is changed to those of a more modern class. The Allegheny plant is described as "poorly designed, inefficient and expensive to operate." Appropriations for technical equipment have been neglected to such an extent, say the reviewers, "that the electrician had to build his own switchboard out of such junk as he could collect from machine shop yards." Of Chicago's four municipal electric plants, three are declared to be of obsolete type, while the fourth is not properly constructed for economical operation. The stations are scattered through the city without system and are very poorly located. The plants use 1,400,000,000 gals. of city water (minimum) for which no charge is made. Of the 6700 lamps in use, 4180 are of a type which has been generally discarded throughout the country. On the subject of operating efficiency, it is set forth that economical operation at Allegheny is much hindered by the unnecessary number of employees. Six or eight of the force could be dismissed, reducing the payroll 15 to 18 per cent, and "the half dozen extra laborers often put on for political purposes at election time could be dispensed with, changes which would add to the efficiency of the service as well as lowering its cost." In Chicago, the civil service rules are declared to be a source of inefficiency. Men who have become inefficient are

held in responsible positions longer than they should be and the best men are often prevented from being advanced in rank or chosen from the outside because of lack of special knowledge required by the civil service examiners.

Under the heading "Financial," an exhaustive review of the economic operations of municipal and private undertakings both in Great Britain and the United States is given by the reviewers, who find that it is admitted by the advocates of municipalization that the debts of British cities have been enormously increased by its operations. "We venture to believe," they say, "that the loss to the communities whose municipal industries we have investigated from bad management and lack of enterprise, resulting in restricted service of modern utilities, is many times the profit these cities claim to have realized from their Rip Van Winkle methods of serving the public. It is not worth while to discuss the effect on the finances of American cities of the municipal operations of the industries that we have here investigated. Properly audited they have, with one or two exceptions, lost money, and their plants are all inadequate to good service and have, with the exception of the water plants, little more than a scrap value in view of the present state of the arts. What effect could such poor efforts as we have witnessed have on public wealth or public comfort? It cannot fail to be bad."

Mr. Edgar and Mr. Clark conclude their present review as follows: "Whatever the subjective relation of municipalizers to their reform their objective relations, as we have seen, is far from what it once was regarding the commodities and services to be municipalized. They have been obliged by the logic of events to cut away from much that seemed precious to themselves and to many who trained with them. Their opponents, taking cognizance of the projects abandoned, hoped that now municipalizers might be pinned down to the consideration of ascertained facts relating to undertakings which their representatives have had an opportunity to visit and to developments obvious to all who are interested in the progress of the debate on the question. The voluntary movement of the municipalizers to this not easily shiftable point would, we submit, in itself have been a contribution to the cause of truth and a source of gratification to their adversaries. But the radical British municipalizer has exhibited the resources of hope and fancy, if not of logic and consistency. While his American comrade is still shouting for municipal ownership, he is today, in his latest frame of mind, looking expectantly to 'municipalization by provinces'—that is, for gas, water, tramways and electricity he now wants national government, appropriation, ownership and operation. He has dropped municipalism and comes out for what he all the time had in the background of his thought—socialism.

"Thus the familiar old song of state socialism is paraphrased. The principle was accepted by leading municipalizers of Great Britain, who appeared before our commission in London, and it is the logical outcome of municipalization. When ex-Mayor Dunne, of Chicago, came out last summer for 20-year franchises for the street car corporations of his city he demolished his platform, ignored his campaign principles and returned to the system of private ownership in the one industry whose reform through municipalization was the loudest cry that gave him his office."

Composite Arc Light Electrodes.

Among the patents issued July 9, are six on composite arc light electrodes, all of which are assigned to the General Electric Company.

A patent issued to Johannes Harden relates to a lower electrode composed essentially of a titanium compound, the upper electrode being either of carbon alone or containing small quantities of titanium carbide, ammonium chloride or magnesium sulphate. The lower electrode may contain 90 parts of the titanium carbide to 10 parts of carbon; or it may consist of 75 parts of titanium chloride, 10 parts of carbon, 3 parts of ammonium chloride, 2 parts of magnesia sulphate and 2 parts of tar to act as a liquid binder. It is stated that while light-producing salts, such as lime and magnesia, are used in some forms of electrode to color the arc, such salts are merely evaporated into the arc by the heat produced, whereas the titanium carbide in the electrode described is ionized by the current, the ionized vapor thus formed serving as the principal gaseous medium through which current between the electrodes passes.

Five of the patents above noted were issued to Robert H. Read. One of these contains five claims on an arc light electrode containing magnesium carbide. With this material may be mixed powdered carbon or refractory oxides to form solid electrodes, or it may be employed with or without these ingredients as a core.

A second patent has four claims on an arc light electrode containing a conducting carbide insensitive to moisture, which may consist of carbide of aluminum. It is stated that this substance gives excellent results either when employed pure or when mixed with a carbonized binder, or it may also be used as a core for a cored carbon; and that a good arc from ¼ in. to ⅜ in. in length may be maintained by one ampere with a drop across the arc of 50 volts.

A third patent contains 11 claims relating to an arc light electrode formed of carbide of titanium or containing a predominating amount of titanic material, which latter may have its pores filled with carbon. It is stated that such an electrode gives a light of extraordinary efficiency, the arc obtained being of the luminous type and of a very good white color.

A fourth patent contains 22 claims for the general case of an electrode containing a carbide decomposable from the action of moisture, and the process whereby such electrodes are provided with a superficial coating impervious to water.

The fifth patent contains a single claim on an arc electrode consisting of zirconium carbide mixed with a suitable carbonizable binding material.

CURRENT NEWS AND NOTES.

ROYAL BIRTHDAY HONORS.—Mr. John Gavey, engineer-in-chief until recently of the British Postal Telegraphs, has been promoted as Companion of the Bath, to knighthood in that order. This recognition will give great pleasure to a host of friends of "Sir John" in this country. Dr. J. A. Ewing has also been made a C. B. Before being appointed Director of Naval Education in 1905, he was for many years professor of engineering and applied mechanics in the University of Cambridge, and there carried on his celebrated investigations and researches in magnetism. We note also that Sir James Kitson, Baronet, well known in engineering and steel industries on both sides of the Atlantic, and a staunch friend of electrical development, has been raised to the peerage, while Sir W. Holland, who has had much to do with cables and wireless has been made a baronet.

RAILROAD SIGNALS.—A special cable dispatch from Berlin, Germany, of July 12, says: "The Prussian railway authorities have been making experiments on the line between Berlin and Stettin to find a method for insuring the efficiency of signals and thus preventing accidents. In the effort to secure a preliminary signal to give warning of a stop signal many devices were tested. These included flashlights by the side of the track when nearing a signal and other visible signs. Electric wave transmission to the locomotives also was experimented with. The method finally selected consists of fastening two or three horns with a rubber bulb, similar to those used on automobiles, to the telegraph poles at intervals of about 100 yards. These are electrically operated, and have been found very trustworthy in warning engineers. The railway authorities have decided to introduce these preliminary signals on a number of roads."

ELECTRIC RESISTANCE MATERIAL.—A patent was granted July 9 to A. L. Marsh on a resistance material composed of 88 parts nickel, 8 parts chromium and 4 parts aluminum. It is stated that the addition of the aluminum doubles the resistance and gives an oxide coating which protects the core against further oxidation. The specific resistance of the oxide is about 50 times that of copper.

METERS AND MORALS.—The Citizens' Gas & Electric Company, of Waterloo, Ia., is, according to the *Progressive Age*, in a novel predicament. The temperance people of the town got an order from the courts compelling all saloons to have their cellar doors nailed up tight and it was done. Now the meter readers cannot get at the meters and the saloon keepers refuse to interfere with the doors.

TRACTION IN GERMANY.—U. S. Consul J. I. Brittain, of Kehl, Germany, advises that a new electric railway has just been opened for traffic from the Alsatian town of Munster to the Schlucht, the summit of the mountains dividing Germany and France. This 6.7 miles line was built at a cost of $285,000, and connects the Schlucht with a similar line extending to Gerardmer, France. The electric omnibus is killing the livery business in many of the towns of Alsace-Lorraine and Baden.

A FOE OF THE FAN.—The following is a serious item from the *New York Sun*: "There is one thing I want to warn you about," said the wigmaker to the man who was buying his first wig, "and that is the electric fan. Whenever you see an electric fan in motion, give it a wide berth. If you don't it is apt to embarrass you. Electric fans and wigs are deadly enemies. Nothing outside of an Indian and a tomahawk will lift a wig from a wearer's head quicker than an electric fan in motion."

NOT FOG BUT KNIVES.—The Springfield, Mass., *Republican* says: "The loss of many English fishing boats is now said to be due to the fact that the helmsman often carries a specially forged fisherman's knife. These knives possess strong magnetic properties and will deflect a compass needle two or three points. This means that the helmsman may be apparently steering a true course, but is in reality much out of the way." In the early days, the seaman who did this kind of thing knowingly was fastened to the mast with his own knife through his hand.

STEAM RAILROAD TROLLEYS.—It is stated that control of the Troy & New England Railway, an electric line running from Troy to Averill Park, has passed to the Delaware & Hudson. The line was purchased, it is understood, for the purpose of rounding out the Delaware & Hudson's holdings of electric lines in and around Troy and Albany. It already owned the United Traction Company of Albany, and with the New York Central controlled the Schenectady Railway. L. F. Loree, president of the Delaware & Hudson, has been elected president of the Troy & New England Railway.

ROYAL TELEGRAMS.—An English magazine states that all royal telegrams pass through the government telegraph office at St. Martin's-le-Grand, and are manipulated by a special operator, who is reserved for this duty. Unlike public messages, no duplicates are kept, and the original messages, in certain instances, are promptly returned to the palace, after a note has been made of the number of words for the purpose of the account. The cipher codes which are used between the Foreign Office and the embassies abroad are not employed for the personal messages of the King, nor is any system of cryptic writing usual between monarch and monarch.

STANDARD TIME.—In a paper on "Standard Time," prepared for the recent Atlantic City convention of the Railway Telegraph Superintendents, Mr. W. J. Camp, electrical engineer of the Canadian Pacific Railway's telegraphs, gave some interesting facts regarding the method of maintaining uniform time along that company's system. Every day at noon standard time is transmitted from headquarters at Montreal and this time is regularly forwarded by cable to Fanning and other islands in the Pacific Ocean and to Bermuda, Jamaica and the Azores in the Atlantic. The master clock is at McGill Observatory. The company maintains a time service department, which keeps a close record of the clocks and all employees are required to carry standard watches. At Montreal there are 81 clocks on five circuits controlled by one master clock. These circuits obtain current from a small storage battery.

POWER PLANT IN NEVADA.—Further details regarding the recent contract made with J. B. Daniels, a mining man, of Wonder and Fallon, Nev., and the United States Government, are to the effect that the Government has agreed to build an electrical power plant on the Truckee River, where the Truckee empties into the Carson, in Churchill County, and furnish power to Daniels for the mines of Fairview and Wonder and also for an electrical railroad from Wonder to Fallon. He states that the Government intends to erect a power plant that will generate 5000 horse-power, and that a portion of this power will be used to operate the gates along the canals of the Truckee-Carson Irrigation Project in Churchill County, built by the Reclamation Service. At the point where the Truckee empties into the Carson, the water falls a distance of more than 60 feet and a large amount of energy can be generated. The plant when completed will be one of the largest in Nevada. There are 15 mines in the Wonder mining district with ore on the dumps waiting to be shipped. As soon as the electrical railroad is built from Wonder to Fallon, Wonder will be one of the most prosperous mining camps in the state.

TURKISH TELEGRAPHS.—U. S. Consul E. L. Harris, of Smyrna, reports on the telegraph service of Turkey, as follows: "The telegraph was established in Turkey during the Crimean war. The first line began working between Constantinople and Adrianople in August, 1855, and was joined to the Austrian line by way of Roustchouk. During the years which followed the telegraph was established over all the Empire, and at present comprises 22,900 miles of wires. The rate was, until 1884, 40 cents per 20 words within the boundaries of one vilayet and from 60 cents to $2.80 per twenty words between two vilayets, according to the distance. In 1884 this system was modified, the rate becoming 2 cents per word, with a surplus of 6 cents in the interior of a vilayet and 20 cents per word between two vilayets. An additional rate of 2 cents was placed on the use of the cables of the Eastern Telegraph Company. This tariff was reduced in 1897 to 2 cents per word within the limits of a vilayet and 4 cents per word between two vilayets. In 1903 the present rate was introduced, which is as follows: Two cents per word within the limits of one vilayet or between two adjacent vilayets and double this amount between two separate vilayets. The Great Eastern Company has cables only north of Smyrna. Its central offices are in the island of Syra. Certain islands, such as Chios, Tenedos, etc., can be reached by telegram only through this company. The equipments, with the exception of those belonging to the Eastern Telegraph Company, are all provided by a well-known German firm. The material of the private lines of the two railway companies radiating from Smyrna have also been imported from the same German firm. As a natural result of the extension of railways right into the heart of the country, large trading centers will soon be established, necessitating the increased use of the telegraph. This is an opportunity which American manufacturers interested in this line of business should not miss."

COLORADO LIGHT, POWER AND RAILWAY ASSOCIATION.—The fifth annual meeting of this thriving association will be held at the Savoy Hotel, Denver, Col., Sept. 18-20. Mr. J. F. Dostal, 406 Seventeenth Street, Denver, is secretary.

BALANCING FIELD EXCITATION.—A patent granted July 9 to Messrs. E. W. Mix and Paul Bunet, of Paris, describes a method of balancing the field excitation of multipolar dynamos with parallel wound drums. This consists, in the case of a four-pole machine, of providing two windings on each pole, one of which is connected with one pair of brushes and the other with the second pair.

JOHANNESBURG MUNICIPAL PLANT FAILURE.—The Johannesburg Municipal Council has shut down its new gas-engine electric plant, which is stated to be an entire failure. It will claim from the contractors $715,000 paid on account and $525,000 named in the bond for the due performance of the contract. The contractors will have to remove all of the machinery installed. A 1000-kw steam plant is being installed to take up at once part of the tramway and lighting load, to carry all of which satisfactorily demands 5000-kw.

TESTING SAFETY DEVICES.—The Interstate Commerce Commission has appointed a board of experts to supervise and conduct experimental tests of block signal systems and other safety devices, as provided for by the joint resolution of Congress. The members of this board are Prof. Mortimer E. Cooley, Capt. Aziel Ames, Jr., Frank G. Ewald and B. B. Adams. In the appointment of this board of experts the commission has the co-operation of the American Railway Association. A sub-committee of that association went to Washington and conferred with the commission with reference to the proposed tests and the composition of the board of experts. The committee has tendered the commission the use of railway tracks and other facilities for conducting the tests and will co-operate to the fullest extent in securing the best results.

THE TELEPHONE IN RAILWAY SERVICE.—At the recent convention in Atlantic City of the Railway Telegraph Superintendents, Mr. S. Lewis Vanakin, Jr., of Syracuse, N. Y., read a paper in which he gave an account of the method employed by the New York Central Lines in operating the telephone lines along their road. In order to obtain maximum service calls are limited during office hours to three minutes, excepting those made personally by the higher officials, whose communications are not subject to the three-minute rule. The latter class of communications take precedence over all other business, and when such service is called for the line between the points concerned is cleared of all intermediate apparatus in order to obtain clear transmission. When the special business is finished the intermediate offices are notified by Morse wire and the telephone line is restored to its normal operative condition. A call between New York and Chicago can be established in about six minutes and the quality of transmission is reliable, by cutting out the intermediate apparatus.

A JAPANESE DINNER.—A dinner was given last week at the Union League Club to Admiral Yamamoto, of the Japanese navy, who has been visiting New York. The hosts at the dinner were Leigh Best, vice-president American Locomotive Company; Walter L. Clark, vice-president Niles-Bement-Pond Company; Charles A. Coffin, president General Electric Company; Charles L. Cornell, treasurer, Pratt & Whitney Company; Charles G. Curtis, president Curtis Turbine Company; W. D. Dimock, New York Shipbuilding Company; John W. Dunn, president International Steam Pump Company; George Westinghouse, president Westinghouse Companies; John P. Ilsley, Niles-Bement-Pond Company; Edward L. Leeds, Niles-Bement-Pond Company; Charles MacVeagh, United States Steel Corporation; Frederick B. Miles, president University Extension Society; F. C. B. and F. D. McKay, first and second vice presidents E. W. Bliss Company; Joseph W. Powell, William Cramp & Sons Ship & Engine Building Company, and Charles M. Schwab, president Bethlehem Steel Company. Informal speeches were made by Mr. Westinghouse, Mr. Coffin, Mr. Miles and Mr. Clark, who acted as toastmaster. Admiral Yamamoto made a brief speech, thanking his hosts for their attention.

FACSIMILE TELEGRAPHS.—U. S. Consul Thomas H. Norton, of Chemnitz, reports as follows concerning the development of telephotography: "Much attention is now paid in Germany to the remarkable measure of success which has attended the installation of Prof. Korn's invention for the transmission by wire of photographic reproductions over long distances. His latest experiments show that nearly as satisfactory results are secured by making use of ordinary telephone wires as on lines specially constructed for the purpose. The only difficulty encountered on telephone wires results from calls on adjoining wires. These cause the formation of zigzag lines on the reproduced picture at the receiving station, which are easily corrected by retouching. Alterations in current intensity by ringing on or ringing off, as well as during conversations over adjoining wires, are without effect. It is further shown that the wire employed for photographic reproduction can simultaneously be utilized for telephonic conversation. The advantages thereby accruing, to journalists more particularly, are self-evident. In these days when so many newspapers have private wires or lease a wire to a distant city for a certain time during the night a correspondent can telephone his dispatches and at the same time transmit the desired illustrative material. The first journal to utilize the new invention is the Copenhagen daily *Politiken*, which has ordered a complete installation for telephonic and telephotographic communication with its Berlin office."

TELEGRAPH COMPETITION.—Mr. Clarence H. Mackay, president of the Postal Telegraph Cable Company, commenting on the proceedings instituted by Attorney-General Jackson, of New York State, against the Postal Telegraph Cable Company and the Western Union Telegraph Company, alleging that the companies had ceased to compete, said in a recent interview: "If two companies ever competed in the United States these two telegraph companies are competing and always have been. At times the competition is even fierce and bitter. Every merchant and manufacturer in the United States, wherever we reach, will bear witness to the truth of this statement. We are litigating with the Western Union all over the country in regard to railroad rights of way. In fact, the tremendous fight between the Pennsylvania Railroad and the Western Union was due solely to the fact that we got that business away from the Western Union. That company is trying to exclude us from all union depots and has just succeeded in excluding us from the Birmingham Union Depot, which is perhaps the finest union depot in this country at present, and we intend to take the matter into the courts to set aside the monopolistic contract between the Birmingham Union Depot and the Western Union. Look at the Cuba cable which we are now laying and which will be in operation by Sept. 30, and which will take a large amount of business away from the Western Union. Look at the Pacific cable, which took business away from the Western Union. Then there are our five cables in the Atlantic and our land line system, which runs into every state in the Union, and is continually taking business away from the Western Union. We are about to construct a new route to the Pacific Coast, passing through the great mining fields, such as Tonopah, Goldfield, etc., all of which will take business away from the Western Union. We are the only company that ever did really compete with the Western Union and succeeded in doing so. Other companies have competed merely to be bought out, and none of them ever paid a dividend in opposition to the Western Union. We are extending our system all the time, and all the time are taking business away from the Western Union. All this talk about the two companies working in harmony is nonsense."

Cleveland Arcade Electrical Plant.

THE Cleveland Arcade Company, Cleveland, Ohio, recently completed a new power plant which contains several features unique in the design of plants for office building purposes. The greatest difficulty to be overcome was encountered in the space limitations, which were found to be rather severe, since the only ground that could be used for the purpose, considering the determination of the company to build the plant outside of the main structure, was a plot 37 ft. x 39 ft. on the east side. The successful operation of the plant shows that even in very small space sufficient power may be developed to take care of large areas.

To understand properly the requirements of a plant of this kind, a brief description of the building it serves will perhaps be necessary. "The Cleveland Arcade" is the largest combined office and store building in Cleveland and one of the largest of the kind in the country, covering 60,000 sq. ft. of area, with a frontage of 135 ft. and height of eight stories on Euclid Avenue, frontage of 185 ft. and nine stories on Superior Avenue and a double frontage of 440 feet and five stories through the length of the arcade. In all, the structure contains 200,000 sq. ft. of rentable floor space, with 530 offices and 60 stores. The radiating surface aggregates 30,000 sq. ft.; the equivalent of 3500 16-cp incandescent lamps are installed and six passenger and two freight elevators are in use. The building is owned by the Cleveland Arcade Company, of which Charles F. Brush, the well-known pioneer in the electric light industry, is the president.

In 1890 the building was completed and the power plant at that time consisted of five 60 ins. x 16 ft. horizontal tubular boilers, hand fired, and three small engines belted to 80-volt Brush incandescent dynamos. Some time later a Russell engine, direct-connected to a 100-kw Elwell-Parker generator, was added. In the winter of 1901-2, in order to comply with the requirements of the city respecting the elimination of smoke, Jones under-feed stokers were installed under the five boilers. Three years ago it became evident that a new power plant must be secured, as the old one was well worn and inefficient for the requirements of a modern building. The decision of the owners to locate the plant outside of the building was based upon the following reasons:

1. A large amount of very valuable space in the arcade that could be used for store purposes would be vacated. 2. The noise, dirt and heat, necessary accompaniments of a power plant, would be removed from the building. 3. The possibility of installing a plant of sufficient capacity not only to meet the demands of the arcade itself, but to supply light, heat and power to adjacent buildings, and thus make the plant, in part, at least, self-sustaining.

In addition to the area of the plot of ground available, 37 ft. x 39 ft., there was opportunity to excavate under a private alley and thus add about 10 ft. in one direction to the basement of the power house. The proposition that was thus placed before the engineers included the following points:

1. To design a plant with maximum capacity to be placed on a lot 37 ft. x 39 ft. in area. 2. To provide storage for a week's supply of coal. 3. To select equipment which would give maximum reliability and economy in operation. 4. To provide suitable means for keeping close record of the operation of the plant.

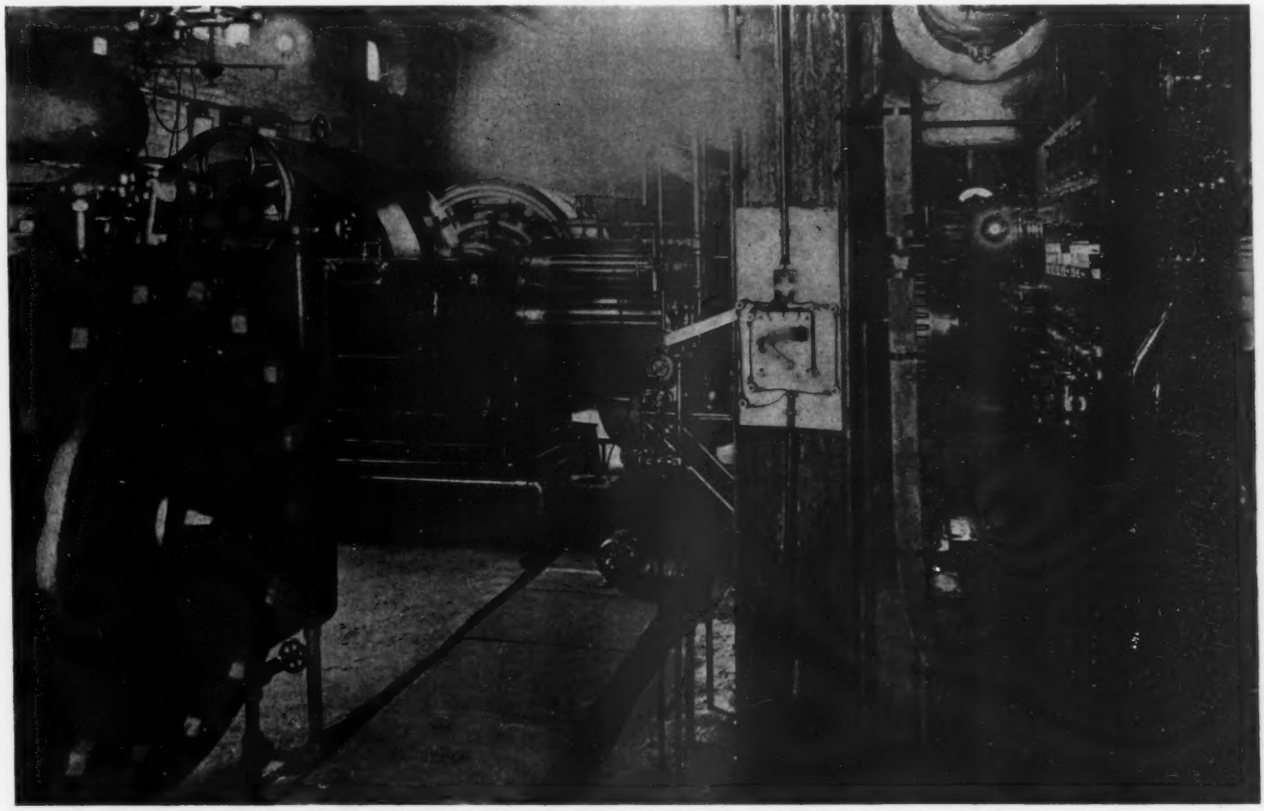


FIG. 1.—GENERATING EQUIPMENT, CLEVELAND ARCADE.

With these limiting conditions before them the engineers decided that a plant of about 1000 hp would be feasible, but to install this a building of practically three stories would be necessary. This plan made it possible to utilize the additional space in the engine room by excavating under the private alley and at the same time made necessary the installation of coal and ash handling machinery.

The floor level of the engine room was made the same as the basement floor of the main building, and the bottom of trenches for piping and cables was kept just above the sewer level. Under all this section of the city lies a bed of clay, sloping generally toward the lake. Above this clay are strata of varying thicknesses of fine, water-bearing sand, often incor-

rectly called quicksand. This wet sand, confined laterally, makes a substantial foundation for spread footings. In this plant the footings and main columns were designed to impose a maximum load of about three and one half tons per square foot on the soil. The column footings and engine foundations were laid about two feet below the water level and may be practically considered as floating in this wet sand, but after more than a year has elapsed they have shown absolutely no signs of settling or moving.

The power building in structure is a simple affair, consisting of an overhead coal bin with a capacity of 200 tons of coal, mounted at the four corners on steel columns; a steel and concrete floor to support the boilers and side walls and roof to enclose the same.

Plate girders 10 ft. in depth form the sides and ends of the coal bin, while the bottom consists of a single sheet rolled in parabolic form, this style of construction affording maximum strength with minimum weight of metal and giving a form of

FIG. 2.—CLEVELAND ARCADE.

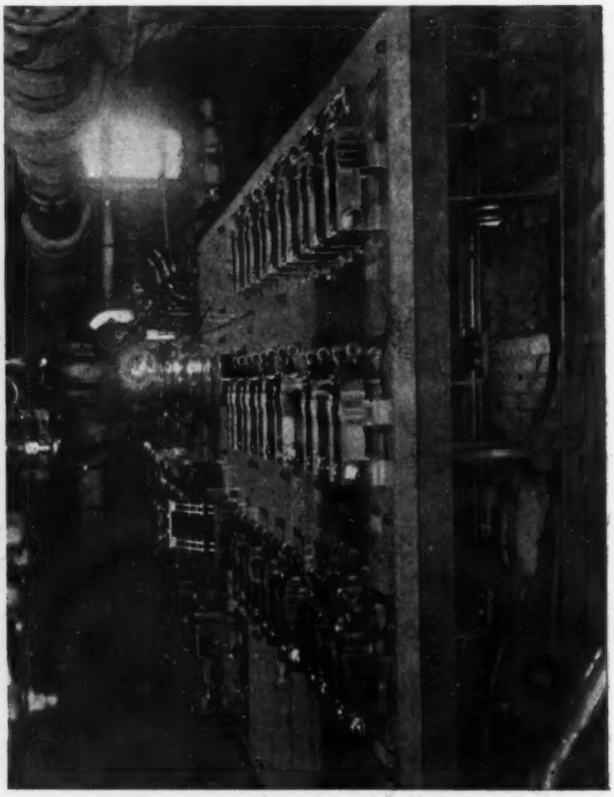


FIG. 3.—SWITCHBOARD.

bin easily emptied. The girders extend through the building on one side, forming brackets on the outside, to which the ash bin is attached. The latter is provided with a spout for delivering ashes directly into the wagon.

A Jeffrey bucket conveyor is used for handling the coal and ashes. Space limitations required that this conveyor should be entirely within the power house, with the exception of a loop that extends out under a driveway. Coal holes have been provided in the driveway, so that fuel is unloaded directly from wagons into a weighing hopper of five tons capacity, suspended under the driveway and delivering into the bucket conveyor. This conveyor is driven by a motor belted to a driving pulley. Suspended from the bottom of the coal bin is a track on which is mounted a traveling hopper designed to hold 1000 pounds of coal. The hopper may be filled at any one of the three openings in the bin, moved along the track to the hoppers of the stokers and emptied where desired. A scale beam is furnished with the hopper so that accurate records of the fuel consumed may be kept. Small ash pockets are arranged under the boiler room floor delivering directly into the conveyor, by which the ashes are carried to the overhead ash bin. The main switch and controller of the driving motor, the scale beam of the large weighing hopper, the cables operating the bucket loading gates and the chain controlling the location of the bucket tripper over the coal bin, are all located in one corner of the boiler room, easy of access and under the control of one man. Emergency cutouts for stopping the conveyor are located over the coal bin, in the boiler room and at several points on the engine room level.

Several points entered into the determination of the engineers to select a three-wire system, principal among which were that the Arcade building covers a large area; that the demands for power as well as light, are considerable; that for a portion of the 24 hours, but one of the three units installed is required; that service is to be supplied to adjacent buildings and that the local lighting company has a three-wire, direct-current system in the business district. The generators determined upon are three-wire, 110-220 volt Westinghouse machines with balancing coils, one of 200 kw and two of 250-kw, each running at 200 r. p. m.

One simple and two compound engines were installed. As the space was limited two horizontal tandem-compound engines, right and left, were specified, in order that room might be allowed for the switchboard between the cylinders. But few makers could meet the space requirements and the Ball engine, made at Erie, was finally decided upon. The compound engines are direct connected to the 250-kw generators and the simple engine direct-connected to the 250-kw generator. Owing to the demands of the building for lighting, the 200-kw machine was put into operation before the remainder of the plant was completed. Part of the permanent steam piping was put in to connect with the old boilers, and one of the switchboard panels was put in position temporarily.

The selection of boilers received careful attention on the part of the engineers, and on their advice, it was decided to install water-tube boilers for 160-lb pressure with 100 degrees superheat. In deciding this question a number of other plants were visited and the cost of repairs, time required for cleaning,

reliability of superheater and other points were taken into consideration. In the end the Stirling boiler with rear-pass superheater was purchased. The boilers are set two in a battery and one single. Each has 2618 sq. ft. of evaporating and 1345 sq. ft. of superheating surface. The claim of the makers was accepted that, since most of the evaporation takes place in the first two banks of tubes, a boiler with a rear-pass superheater should be rated on 8½ sq. ft. of evaporating surface per horse-power, making them 308 hp each. Flooding pipes connecting to the superheater drums are provided and they are guaranteed to operate as saturated steam boilers and deliver dry steam under those conditions. Their rating is thus increased to about 400 hp, based on 10 sq. ft. of evaporating surface per horse-power. Operated in practice both as superheater and saturated steam boilers, they have given satisfaction.

Two Jones under-feed stokers were installed under each boiler. They are provided with special hoppers holding 1000 pounds of coal. The stokers are the latest type with Cole automatics, the air supply being furnished by an American blower, driven by an A B C engine. The speed is regulated by a Foster valve which responds readily to change in boiler pressure, regulating both the air and coal supply. An automatic motor drive was also installed, the motor being under the control of a Cutler-Hammer controller operated by change in steam pressure. The boilers are raised high enough from the floor beams to permit placing of air ducts and steam pipes for the stokers in the floor.

The conditions that determined the choice of stokers were that the Jones underfeed, used in the old plant three years, had given satisfaction both from point of economy and smoke prevention; that the new plant has a rated capacity two and a half times that of the old plant and that the old chimney was to be used, so that forced draft would probably be required; and that the boilers being located over the engines, it was necessary that the ash and clinker should be taken out in front of the boilers where the ash holes are located.

Lack of ground space and cost considerations made it necessary to use the old chimney, which is 175 ft. high and 5 ft. inside diameter. The location of the boilers above the ground level reduced the effective height of the stack about 15 ft. and their location increased the horizontal travel of the gases 50 ft., besides adding two right-angle turns. Such conditions made the under-feed type of stoker with forced draft seemingly necessary and the results have shown that the conclusions were well founded.

Necessity for using the feed-water returns from the heating system in the building and space conditions fixed the location of the feed pumps and feed-water heater in the space excavated under the alley-way and on a level with the engine room floor. Two Snider-Hughes monitor duplex plunger pumps for 200-lb. pressure were chosen. The feed-water heater is a Webster open heater for 1000 boiler horse-power.

All high-pressure piping, valves and fittings were specified for 150-lb pressure and 100 deg. superheat. The main headers in the engine room and boiler room and the vertical lines connecting the same are 12-in. pipe. Both boiler room and engine room headers are furnished with gate valves located so that the headers may be separated into sections and a boiler and engine separated from the remainder of the plant for testing. The simple engine and elevator pumps are supplied by a 10-in. branch line. A Keiley reducing valve in this line reduces the steam pressure to 100 pounds. Through a Kieley low-pressure reducing valve, connection is made with the heating system, since live steam is occasionally needed in heating the building. The 16-in. main line of the exhaust piping connects with two 12-in. branches to the heating system, with a 10-in. branch to the feed-water heater and with a 14-in. branch to the exhaust head located near the top of the stack. All exhaust piping is laid under the engine room floor. Both high and low pressure lines are drained and trapped with Squires traps and the exhaust pipes are furnished with Webster oil separators.

Each boiler, in addition to the feed line from the pumps, is provided with a Penberthy injector and also means for filling from city pressure, and each is provided with a Squires feed-water regulator. The feed pumps have each a Squires pump governor. The boilers each have a Foster non-return, automatic, emergency stop valve, with pilot valve in front of the boiler so piped and arranged that any boiler may be cut out of

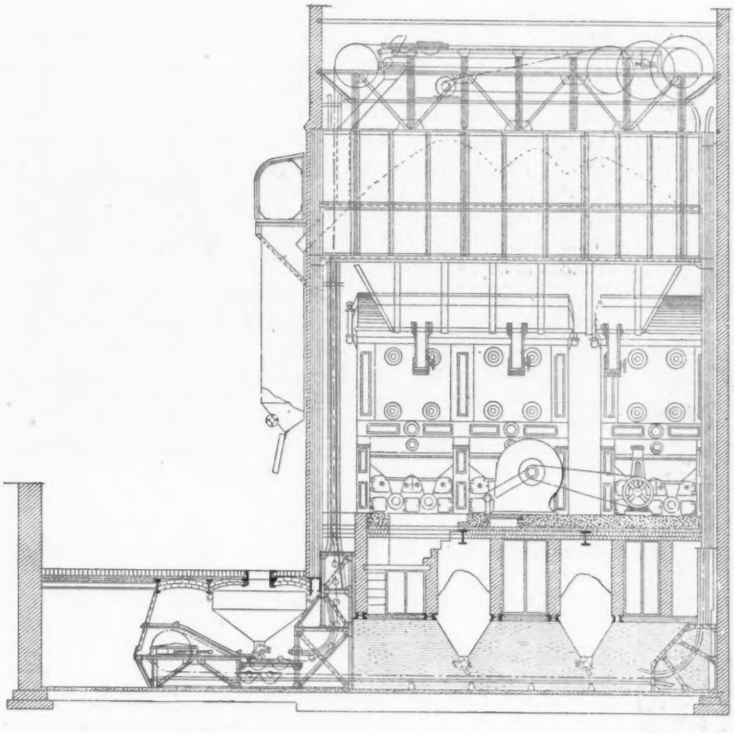


FIG. 4.—ELEVATION OF BOILERS AND COAL HANDLING APPARATUS.

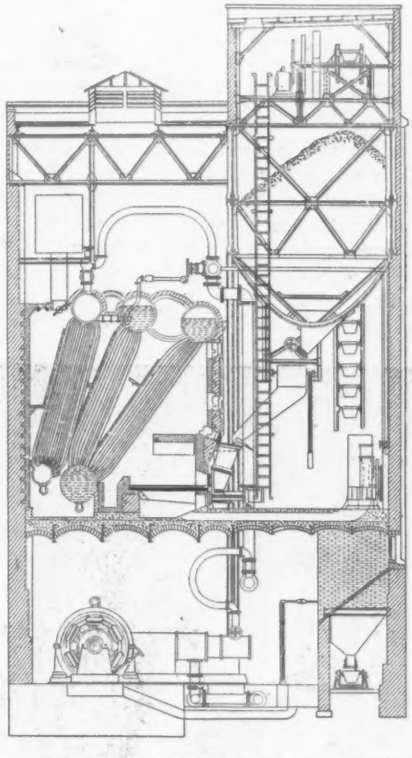


FIG. 5.—SECTION THROUGH COAL BIN, BOILER ROOM AND ENGINE ROOM.

service from the boiler room floor, or the whole battery may be shut down by opening a small valve in the engine room. Each boiler has a Worthington 2-in. hot-water meter in the feed line with by-pass connection and all are equipped with Vulcan soot blowers and flue cleaners.

An oil tank holding two barrels is suspended from the boiler room floor and connection is made to the outside of the building, so that oil can be delivered without unloading the barrels from the wagon. From the tank the oil is piped to the bearings of all the engines and from there flows to a receiving tank under the engine room floor, whence it is raised by a motor-driven centrifugal pump to an oil filter in the boiler room, and from there it flows back to the tank.

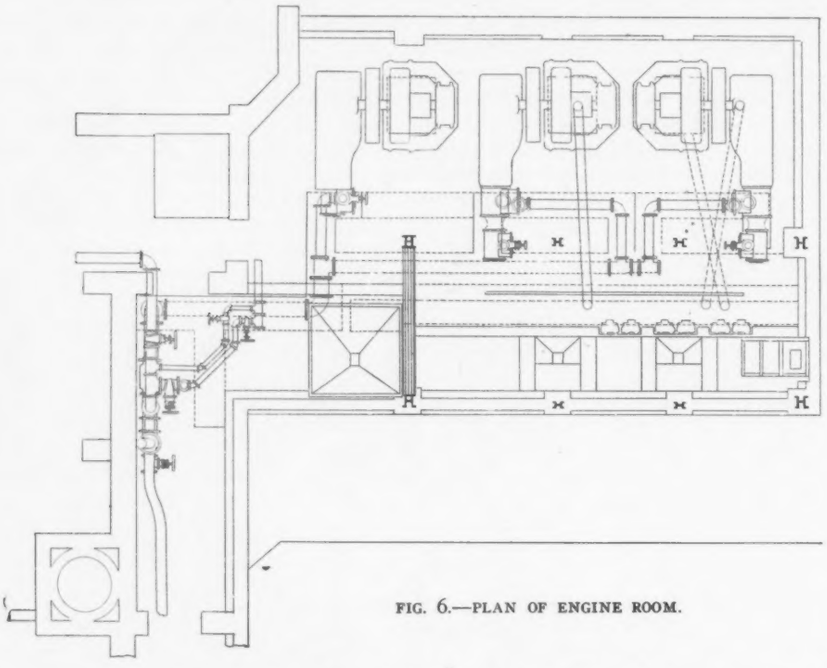


FIG. 6.—PLAN OF ENGINE ROOM.

The Paul vacuum system was installed as part of the heating system. The engineers felt that, in order to remove the back pressure on the engines, insure smoother running of the plant and secure a better circulation throughout the building, a vacuum system was necessary.

FIG. 7.—BOILER ROOM.

The generating panels, containing the usual switches, circuit breakers, ammeters and a Thomson watt-hour meter on each generator, were furnished by the Westinghouse Company. They are of blue Vermont marble. The remainder of the board was designed by the engineers and installed by a local firm. In general appearance it conforms to the generator panels. The station panel contains Bristol recording voltmeters and recording ammeters, showing total station output. An exchange panel provides an emergency or exchange connection with another power plant of similar size in the business section of the city. The exchange panel contains two watt-hour meters, a three-pole, double-throw switch and indicating two-way reading ammeters. Direct telephone connection between the two plants makes it possible for either plant to take the load of the other in cases of emergency. The watt-hour meters are wired so as to record both the energy furnished and the energy received by the plant in the exchange service. Four panels of a similar design make up the feeder board, and on these are mounted switches and fuses for power and lighting circuits both in the Arcade building and for outside service.

In line with the switchboard but separated from it by the main stairway, are two panels of similar design containing steam, vacuum and water gauges, together with a Bristol recording steam pressure gauge and a Bristol recording thermometer connected with the high-pressure lines.

Ducts passing under the trenches for the exhaust lines are provided in the engine foundations for the cables from the generators to the switchboard. As their location is below the water line, lead covered cable is used for these lines, as well as all the main distributing circuits. Distributing cables both for the Arcade and the outside service are laid in a trench back of the switchboard, and the distribution for the Arcade is all underground work of the most modern approved design, with manholes at convenient intervals. The wiring for lamps and motors is all in iron-armored conduit.

One of the most important features of this plant is the complete provision made for tests and records. All coal is weighed and arrangements have been made for regular analyses of the coals, so that contracts may be made on the heat-unit basis. A water meter has been arranged on the cold-water line to determine the amount of water used, and hot-water meters are installed on the feed lines of each of the boilers to keep track of the evaporation. Thermometer wells are placed in the cold-water line, the feed line, at the steam outlet from each boiler, in the main steam header, in the steam header beyond the 100-lb. reducing valve, at the throttle of each engine, at the receiver between the two cylinders on the compound engines and on the exhaust line. Each boiler is piped from the ash pit, from the fire box and from the up-take to a manifold placed conveniently on the wall of the boiler room and connected to a permanently placed draft gauge. A pyrometer for flue gases, recording thermometer on the steam line, recording ammeters and voltmeters on the switchboard, recording pressure gauge on the gauge board, watt-hour meters on each generator panel, watt-hour meters on the circuits for the motor driving the coal conveyor and the motor driving the blower for the stokers, and also on the lines supplying energy to power house, on the circuits supplying the Arcade buildings and those supplying outside circuits, give the engineers in charge the means of keeping the plant at the highest state of efficiency.

The Cleveland Engineering Company made the plans for this plant and overcame the difficulties imposed by small space and otherwise. To Mr. H. W. Woodward, general manager of the company, we are indebted for facilities in preparing this article.

The Selection of Machine Insulation Material.

BY WILLIAM S. CONANT.

IN these days of prepared insulating fluids, the formulas for which are not printed upon the can labels, and of ready-made insulation cones, strips and bobbins prepared to fit all the best known generators and motors, there is danger of losing what was once the common property of the thoroughly equipped electrical repair shop. I refer to a knowledge of the relative insulating value of the materials used in the rewinding of armatures and field coils and in the designing of electrical apparatus of all kinds required to withstand high tension.

It is not intended to decry the advantages obtained through the purchase of commercial products. Fluid insulators can be made in large quantities with greater care and economy in the preparation and mixture than is possible in any but the largest repair shops. Expensive machinery, too, is often a means of perfecting the quality of a product; it is, of course, a necessity in the manufacture of any of the insulators marketed in solid form.

Nevertheless, the writer believes that a discriminating sense of what "good insulation" means for each particular location is too seldom found among either our builders or repair men. The subject is covered thoroughly by the better class of electrical manufacturers, but repairs are necessary sooner or later and the owner of a burned out machine is always reluctant to lose the time required in shipping it back to the maker. A number of enterprising repair houses in the larger cities have built up a large trade, but intelligent and permanent repairs should be available in every good-sized town. The chief obstacle to this end is the absence of a working knowledge of what constitute the best insulating materials.

The practical electrical shop worker may ignore all discussion of the insulating value of air or of oils and gums in their fluid state. These considerations belong more properly to line construction problems or the design of apparatus for high tension transmission.

Materials intended for the insulation of electric machinery should pass three classes of requirements, involving tests to withstand (1) current leakage, (2) lightning discharge, and (3) heat. These classifications may be made to include as kindred under (1) not only the actual insulation resistance tests, under any set of conditions measured in megohms, but hydroscopic or moisture resisting tests which affect the insulation resistance of many porous materials; under (2) determination on resistance to disruptive discharge from any cause, whether accidental metallic contact with a high-tension transmission line wire, proximity to high-frequency wireless station apparatus or static discharge during a thunder storm; under (3) tests covering the effects due to the presence or absence of heat, such as the mechanical failure of materials with extremes of temperature and with rapid alternation of heat and cold.

It was formerly customary to regard tests showing current leakage as decisive. When, however, it was proven that the results could be made to show wide variations by drying out the materials under test, experimenters have very properly transferred their chief interest to high voltage "break-down" tests. The practical distinction is that the break-down test should show the mechanical condition of a material, while the insulation resistance is only an indication of its hydroscopic condition, and therefore of little practical value. The two classes of tests have no definite connections.

No station leads from an overhead line can be absolutely protected from lightning discharge, and too frequently the high-potential strain from this cause reaches the insulation of electrical machinery. Disruptive discharge, whether from lightning or other source, acts like a fluid in motion with erratic splashings which have been called side flashes. These uncontrolled discharges have been found to strain and break down the insulation at any point, but are most liable to follow surface leakage as in taped windings or over a moisture-soaked varnish. Discharges will leap over such surfaces and cause short circuits and grounds by the secondary effect of the following dynamo current in burning out the machine insulation. Designers therefore as far as possible avoid the materials which promote these risks and allow large margins of safety in the actual disruptive strength of the insulating layers.

The mechanical design of a machine may allow in many places the use of a thick layer of insulation and thus a greater selection of materials is available. Often, however, the insulation layer must be extremely thin and great care is required in its preparation. In either case tests to determine the disruptive strength of a material should be made on such thicknesses as are designed for practical use. For instance, mica in its natural state is in a class by itself, will withstand approximately ten times the e. m. f. applicable to other sheet insulations, and various samples of mica should be compared in thicknesses measuring either .1 mm or about 5 mils (.005 in.). A suitable thickness for test samples of most other materials is 1 mm or .04 in. This comparison of equal thicknesses of different materials is important as it has been found by trial that the disruptive strength does not increase directly with the thickness of the dielectric. Mica and paraffin seem to be about the only insulating substances of which this is practically true.

At first thought it might seem to be an easy matter to select all the obviously best insulating materials, solid and semi-fluid, to combine them in various proportions and to submit them severally to a series of tests to determine definitely their relative values as insulators. Unfortunately the specific resistance of insulating materials varies widely under changes of external conditions and does not follow the results of similar tests upon electric conductors. A change in the condition of heat or of moisture will often effect a decided change in the relative value of a simple or compound dielectric, and thus it becomes impossible to prepare a graded tabulation of insulating materials to correspond with those compiled for the electric resistance of metals. We are led, therefore, to experiment with the treatment of varying the thicknesses of insulating materials and to select those which do not break down under high-tension tests. Then we must again apply to the materials passing these requirements, working conditions of heat and moisture for definite periods of time and eliminate those samples which are adversely affected.

Some samples may have tested out well for current leakage and disruptive discharge while dry and cold, but, losing such qualities in a damp or hot place, they are proved to be dangerous where such conditions can take place. Thus wood, paper or any textile fabric, unless especially treated, loses its insulating value promptly in the presence of continued moisture in the air.

Similarly, insulating sheets soaked in resinous gums or coal tar, while for a time withstanding high pressures, become "tacky" and break down after a critical temperature is maintained for a few hours. Sometimes the effect of a long application of heat is to cause the insulating material to check, become brittle and finally char. This charring temperature appears to be a determinate figure for each material due to the fact that the moisture (the disturbing element) is necessarily cooked out at such temperatures. Where untreated fabric with necessarily low charring temperature is used as insulation, such as cotton-covered wire for field or armature windings, it is necessary to saturate the insulation in a high temperature varnish. Its charring limit is thus raised above the danger point.

The charring temperatures for the following materials was obtained by immersing samples in a bath of lead, tin and antimony having a melting temperature of 230 deg. F.: Shellacked cambric, 320 deg.; oiled duck, 8 oz., 338 deg.; oiled duck, 10 oz., 347 deg.; drilling, untreated, 347 deg.; cambric, untreated, 355 deg.; leatheroid, 360 deg.; thin silk, oiled, 392 deg.; thin silk, untreated, 428 deg.; surgical brand cotton, 447 deg.; glazed pressboard, thin, 465 deg.; glazed pressboard, thick (.03 in.). 483 deg.; fine linen, 483 deg. The oiling was in each case with linseed and its result was to lower the carbonization point.

In an article of this scope there is scarcely space for the de-

scription of apparatus used for testing, but it may not be out of place to refer to some of the causes for the apparent discrepancy of test figures coming from different sources. If the disruptive strength of a material per thousandth of an inch is to be found, it is obviously important to use consistently either direct or alternating current. For convenience in obtaining high pressures alternating current is preferable. Uniformity of results are also only obtainable by using rounded disks for terminals. The proper size for these disks is a matter of dispute, but a fair average might be formed in the size of a silver quarter dollar or shilling. Again, it is absolutely necessary in order to obtain consistent results to compare approximately equal thicknesses of material tested. Lastly, the time conditions must be equalized for each sample—by which is meant that the causes which affect the insulation strength of a material (whether electrical or mechanical pressure, heat or moisture) should be applied under equal conditions for the same length of time to each sample. Fifteen seconds is a suitable period for the application of electric strain. A longer period may heat and consequently weaken a sample unduly. Newly-made samples should not be compared with those which have stood for some time. The "green" sample may not have reached its natural strength, while aged samples have had opportunity to develop intrinsic weaknesses due to internal chemical decomposition.

Some test figures might be added illustrating the points emphasized. Also perhaps some notes upon the characteristics of certain mixtures and the effects of certain ingredients.

Mica.

It can be safely said that no satisfactory substitute has been found for mica in commutator construction. The commutator is the hottest part of a machine and mica will not carbonize. Between segments nothing but amber mica should be used, as it can be turned in a lathe without chipping as deep as other varieties and thus the risk of pitting and subsequent flashing under the brushes is lessened. White mica is harder than amber but much more flexible. A good quality of white mica splits into larger sheets and its flexibility makes it most applicable to repair work, particularly on old surface-wound machines. All variations from white, noticeably greenish or

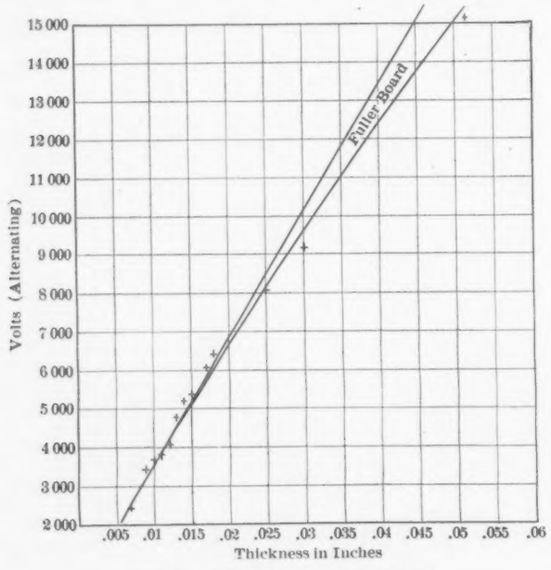


FIG. 1.—TESTS OF FULLER BOARD.

bluish tinge, are harder and more brittle. Metallic veins and chemical impurities are the bane of the mica dealer.

The ultimate disruptive strength of a selected quality of amber mica taken from a number of samples of thickness up to 5 mils, varied from 1980 volts per mil to 4300 volts, the average failing is about 2500 volts. The averages of two assortments of poorer grade mottled samples from different localities were 2200 and 2400 volts per mil respectively. White mica in both large and small sheets averaged 3100 volts per mil. Similar qualities of mica show little difference in strength whether mined in the United States, Canada or India.

Mica Compounds.

The successful building up of thin overlapping sheets and the moulding of finely divided mica into plastic forms has simplified the insulation of many machine parts. The use of hydraulic presses produces a uniform product. These insulations known under several trade names, share to some extent the insulating value of mica. Built up mica, if cemented with a non-hydroscopic varnish, possesses a disruptive strength practically proportional to the thickness. Backed with tough paper or cloth

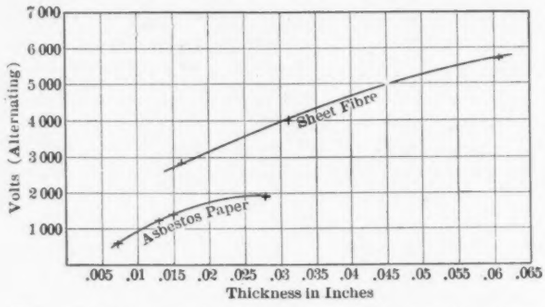


FIG. 2.—TESTS OF SHEET FIBRE AND ASBESTOS PAPER.

for mechanical strength, it has advantages over pressboard or other fibrous insulators for core, slot or coil work. Micanite can be made to within .01" of desired thickness and can be milled even closer.

Sheet Insulation.

One of the most widely useful insulations is flexible glazed pressboard. Thicknesses over .03" should be avoided. If space must be filled it is better to use two thinner sheets. The best quality is made of leather findings and comes in yellow and red. Spruce or other wood fibre is unsatisfactory mechanically unless a sulphide process is used, when, on the other hand, its insulating quality is reduced. The unexpected presence of pin holes or non-insulating particles too small for detection by the eye is the chief fault of this material.

In Fig. 1 is plotted a series of readings, each point representing the average of eight breaking voltages on a given thickness of fuller board. The thicknesses tested were from 7 mils to 51 mils and show a uniform increase in disruptive strength rare in sheet insulation. Even on the thickest sample tested the strength was only 14 per cent below the theoretical straight line of strength proportional to thicknesses, while for a thickness of .025" it was but 6 per cent below.

For thicker insulating sheets the whole family of vulcanized or hard fibre preparations is available, including such kindred materials as bone fibre, kartavert, amyloiden, leatheroid, etc. Where flexibility is required the temptation to the maker to use glycerine is often fatal to the electrical properties demanded. Baleen or whale oil is less harmful for this purpose. This is the class of materials, too, where moisture plays havoc and where, after thorough drying out, the insulation resistance may usefully be measured. Pressboard and vulcanized fibre shrink when hot and swell when damp. Drying out adds about 20 per cent to their disruptive strength.

Hard rubber compounds are some of them also used as sheet insulation, especially those vulcanized with asbestos fibre. Flexibility is, of course, impossible and sometimes such material will ignite when brought into contact with a flame. Unless the asbestos fibre is long the sheet will crack when strained. The chief objection to these products is the presence of sulphur, introduced to hasten vulcanization but causing swelling and blisters under heat and subsequent short circuits. 1/32" sheet vulcabeston will break down at about 2600 volts. Asbestos paper and mill board are not insulations but a fire-proofing material. Thin paper (.007") will be punctured under a pressure of 500 volts.

As an illustration of the variable insulating value of one of

these fibrous materials the following list is given. All were made by one company:

Thickness.	Color.	Disruptive Strength.
.019 (1/64″)	Gray	4000 volts
.035 (1/32″)	Red	3000 "
.042	Gray	6000 "
.051	Black	5200 "
.088	Red	8000 "
.101	Black	above 8000 "

Treatments and Composite Insulations.

Varnished cloth and paper are greatly valued necessities, but the day of the simple gum varnish is past. It is now generally recognized that other treatment than that of dipping in a hot bath of melted copal gum or shellac is required if insulation is to stand at a constant value. It was found that these varnishes, which flowed so smoothly and gave such high insulation resistance, soon "checked" when chilled. They are entirely suitable for instrument coils but on a machine coil will crumble away under vibration. Moisture in the air soon finds its way through these minute cracks and then chemical and electrolytic decomposition follow.

Another objection to these simple gum varnishes lies in the fact that they must be dissolved in alcohol, naphtha or some highly volatile fluid. The result is the presence of danger of inflammability during and after application and wastefulness due to evaporation. The expense here involved is applicable to alcohol paints as well as varnishes, while in either when fresh the alcohol actually serves as a conductor. The writer remembers when it was customary to waste between $25 and $50 in "Woodman's black" on the coils of medium sized railway generators.

Asphalt, bitumen and the other mineral pitches have also fallen under just criticism similar to that bearing upon the gum varnishes. Linseed oil, when thoroughly boiled out, has been combined in many successful varnishes. A mixture with copal applied to press board and thoroughly baked practically doubles the disruptive strength of the board. It is only when the test of time is applied that the material breaks down. Linseed oil varnish will in time oxidize and crack. It, like the gum, is acid and must attack both metal and organic material with the usual results.

The attempt has been made to protect copper from corrosion by coating the surface with paraffin treated to withstand heat. Similar materials have also been successfully combined with resin in the preparation of a varnish which has permanent insulating characteristics. The only absolute test in this matter is that of actual service over an extended period of time under aggravating conditions. Often several layers of insulating varnishes for different purposes are desirable, particularly on a refractory machine, which has more than once burned out under the direct effect of trying local conditions. First use a non-corrosive varnish next to the coils and last of all a weather and acid-proof finish.

Insulating fibre in any form is improved by application of varnish but this advantage is lost unless the material remains plastic indefinitely, and this is the object sought by the insulating expert. Another and sometimes independent object, has been to obtain a heat conducting and diffusing quality in the insulating fluid.

In general the purchase of quick driers should be avoided and some form of oven arranged for baking out coils and armatures. The ingredients which cause a paint to dry quickly are apt to decrease its insulating quality. One maker of insulating varnish states as a rule that there should be a disruptive strength in a good varnish of at least 1000 volts per layer of 1 mil in thickness applied 1 minute in an air temperature of 70 deg. F.

In the matter of fabrics it is an advantage to use that commercially prepared by an experienced firm, as the emulsions and processes are presumably the result of expert treatment. So-called "empire cloth" is simply cambric carried through a hot oil bath, but it is difficult to duplicate its electrical strength without the special machinery used in its treatments—preliminary, insulating and drying. If unprepared cloth is bought it should be unbleached to avoid the chemical action of chlorine, and smoothly ironed to avoid minute roughness in the finished insulating layers.

Needless to say, many of the insulating paints still sold are unsatisfactory and unserviceable mixtures, but these will sooner drop out of use if the purchaser is able to specify what ingredients and results he knows to be injurious and can state reasons for his demands.

Graphical Method of Determining Power Factor from Wattmeter Readings.

BY A. A. RADTKE.

When two wattmeters are connected to indicate the power in a three-phase circuit, the two indications are respectively:

$$W = e\,a\,\cos\Theta$$
$$W_1 = e_1\,a_1\,\cos\Theta_1$$

Now, when the circuit is balanced e and e_1 are equal and likewise a and a_1 are arithmetically equal; hence,

$$\frac{W}{W_1} = \frac{\cos\Theta}{\cos\Theta_1}$$

and,

$$\Theta = \phi - \alpha$$

and

$$\Theta_1 = \phi + \alpha$$

The equation then reads:

$$\frac{W}{W_1} = \frac{\cos(\phi - \alpha)}{\cos(\phi + \alpha)}$$

which can be transformed to

$$\frac{1 + \tan\phi\,\tan\alpha}{1 - \tan\phi\,\tan\alpha}$$

Since alpha equals 30°, $\tan = \frac{1}{\sqrt{3}}$

Then solving this expression for tan ϕ gives the well known form $\tan\phi = \frac{W - W_1}{.577\,(W + W_1)}$

In order to interpret this expression graphically we resort to a construction shown in Fig. 2. Let the two ordinates of the

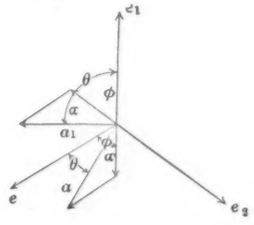


FIG. 1.—VECTOR DIAGRAM.

point D, AD and DC, represent in magnitude the two readings of the meters. Now, with D as a center lay off from the point D, CD on the line AD, locating the point H and the point K on the same line extended. The line AH then represents the numerator of our equation $W - W_1$; and the line AK represents that portion of the denominator within the brackets $W + W_1$. In order now to represent $.577(W + W_1)$, we lay off the line BN and let it represent unit length and on it locate the point M at a distance .577 from B to N. Connect NP and draw the line MF parallel to NP. The line BF then represents in magnitude the denominator of the equation $.577\ (W + W_1)$. Then laying off AH on the vertical axis, locating the point E, and completing the parallelogram $BEGF$, we can now draw the diagonal BGS, which defines the angle of lag, WBS.

The cosine of the angle can now readily be determined. Draw the arc of a circle SWJ with B as its center and consider the radius as unity. Where the line BG extended intersects the arc of the circle, drop the perpendicular ST to the horizontal axis. The line BT then represents the cosine of the

angle of lag for the condition represented by the two wattmeter readings.

Where it is desirable to read at once the angle of lag, knowing the readings of the wattmeters, a curve *XYX* can be drawn following the direction before given, by laying off the lengths of the lines *BT* from the point *V* vertically and projecting their upper ends horizontally until they meet the diagonals of the parallelograms formed from the individual wattmeter readings; for example, *BDR*, and drawing through these points a curve,

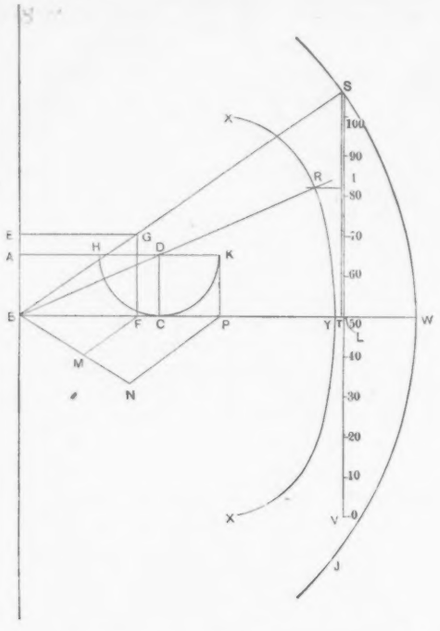


FIG. 2.—GRAPHIC EXPRESSION OF EQUATION.

as shown. When the curve is once constructed it is only necessary to draw the parallelogram representing the two wattmeter readings and then by extending the diagonal until it intersects the curve *XYX*, the power factor can be at once read opposite its horizontal projection upon the vertical scale *SLV*.

From this curve it is at once clear that when the angle of lag is 60 deg., the power factor is 50 and one of the wattmeters reads the total power likewise, when the angle of lag is 0 deg. the two wattmeters read equal and the power factor is unity.

Ground Wires and Choke-Coils for Lightning Protection.

By D. S. Carpenter.

The last few years have seen the installation and successful operation of 66,000-volt power systems. Great credit is due the engineers who have been pioneers in this work and who have proved that 66,000 volts can be controlled with ease and safety. So great confidence has been inspired by the success of the 66,000-volt systems that 100,000-volt installations are now proposed. Perhaps the most interesting part of the history of these high-tension systems is their experience with lightning and the devices which they have adopted to protect their systems. High-tension systems are designed to deliver power at great distances from the point where it is generated and so in general are exposed to lightning discharges, especially in countries where severe thunderstorms prevail.

Tests made with high-potential discharges show that the discharge is preceded by brush discharges and pilot sparks which increase in length until the air-gap between the extremities of these arcs gives way under the strain and the spark is established from electrode to electrode.

When a charged cloud appears over a transmission line there is an induced charge on all conductors within the field of influence. The greatest potential difference exists between the cloud and earth, and if the cloud charge should be transferred to any conductor insulated from the earth, there would exist a potential difference between the conductor and the earth; it is thus evident that the ultimate destination of the lightning discharge must be the earth. It follows directly from this reasoning that if the transmission conductors are removed from the direct path of the discharge from cloud to ground, a direct stroke will be avoided.

The most practical and effective manner of accomplishing this result is to install a ground wire directly above the line. The argument has been advanced against the overhead ground wire that it can afford but little protection, due to the fact that it is practically at the same distance from the cloud that the line conductors are, and lightning is thus just as likely to strike the line conductor as the ground wire. Theoretical investigation and practical experience show that this argument is fallacious. From the above description of the manner in which the static spark establishes itself, it is evident that in cases like this where the tension may exist for some time before the discharge takes place, the potential may be just sufficient to establish the arc through this distance, the potential breaking down successive portions of the air-gap intervening between it and the ground, and thus the last portion of the path over which it passes as it reaches earth will be determined by the relative length and impedance of the possible paths it may traverse. It is evident from this view of the lightning discharge that it will surely strike the ground wire rather than the line if it is above the line, as the distance along this path is less, the resistance is less, and the stress in the intervening dielectric is greater.

Prof. Jackson has shown that the ground wire reduces the potential of the transmission line due to the cloud charge so that there is not as great an induced charge on the power line as when it is absent and less energy directly associated with the cloud charge appears in the power system when the cloud discharges.

An overhead ground wire with lightning arresters installed at intervals along the line affords the best possible protection to the line.

The principle of the choke-coil that it serves to reflect waves and surges in whole or part and thus prevents the station apparatus from being subjected to potentials of such magnitude as to endanger their insulation, is admitted to be theoretically correct, and all engineers advise the installation of choke-coils with arresters.

It has been stated that the air choke-coil as ordinarily designed may not protect in the case of a steep wave of very high frequency, as the full potential exists between the first two turns, and the charge passes across the air-gap between the turns. Proceeding thus from turn to turn it passes beyond the choke-coil and the apparatus is subjected to the full stress of the impact. This would also happen in the case of the insulated coil with the result that in the latter case the choke-coil is permanently short-circuited and the coil is put out of commission. It is easily seen that the insulated choke-coil may be destroyed, necessitating a shut-down of the station to remove it for repairs. It must also be tested at regular intervals to determine whether or not it is in perfect condition.

In regard to the use of the outer windings of a transformer as a choke-coil or to placing a choke-coil inside an iron case, the following disadvantages may be noted. When a charge reaches the choke-coil, since the case is a grounded conductor, there will exist a stress between the charge on the wire and the induced charge on the case, tending to cause a discharge to take place over the surface of or through the bushing through which the conductors enter the case; to prevent this in the case of high tension systems such as now contemplated is difficult. It is probable that the air about high-tension transformers is ionized, so that arcs are established much more easily and through much greater distances.

In regard to the contention that the choke-coil may prevent

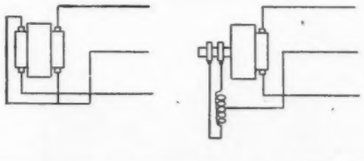
the passage of a charge bound in the remote windings of a transformer, it may be said that the charge when released will first meet the inductance of the nearest turns of the transformer which at the moment of release will act as a choke-coil, and the actual choke-coil will be electrically far from the field of action and will not be a factor in determining whether the insulation will withstand the shock or not.

The manner in which the clouds become charged with electricity indicates that a charge of great magnitude and enormous potential may exist on a cloud. The theory has been advanced that evaporation is attended with electrification each minute particle of water having its minute charge. These particles unite to form larger drops, the potential of which must necessarily be higher. It is also possible and probable that the clouds may assume the potential of the surrounding air, the charge of opposite sign to that of the air readily escaping, and the reactions of these charges upon one another may lead to the concentration of large quantities of electricity on a limited portion of the clouds. These charged cloud masses may unite, causing the resulting cloud mass to have a higher potential. The above processes may be repeated until the potential becomes great enough to cause a discharge to take place from the cloud to earth or to another cloud charged with electricity of opposite sign. It is impossible to prevent oscillations being set up in a system due to lightning discharges in the immediate vicinity of the line. Properly designed protective apparatus will prevent these oscillations from developing high power surges.

Three-Wire Dynamos.

On page 1211 of our issue for June 15 there was given an abstract of a paper on balancers versus three-wire dynamos, which was read by Mr. Budd Frankenfield at the Washington convention of the National Electric Light Association. In addition to the discussion of the relative merits of balancers and three-wire dynamos, the paper contained much interesting information relating to the various types of three-wire dynamos that have been placed on the market.

One of the oldest three-wire dynamos is the machine shown in Fig. 1. This dynamo, which is accredited to Hopkinson, is provided with two equal armature windings and two commutators. The two windings are connected in series and to the neutral wire of the lighting system. In regulation, this machine possesses the advantageous feature that any reduction in voltage due to armature reaction affects the e. m. f.'s of the two windings equally, the only difference between the two delivered voltages being the excess of resistance drop in the heavier loaded winding on an unbalanced load. The armature must be made longer than one for a two-wire machine on account of the two commutators, and the shaft somewhat heavier. This requirement makes the saving in floor space and in first cost less than one's ideal of a three-wire dynamo leads him to expect. Furthermore, it is impossible to regulate the voltages independently except by shifting the brushes—hardly a practical method.



FIGS. 1 AND 2.—HOPKINSON AND DOBROWOLSKY THREE-WIRE DYNAMOS.

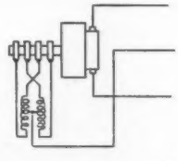
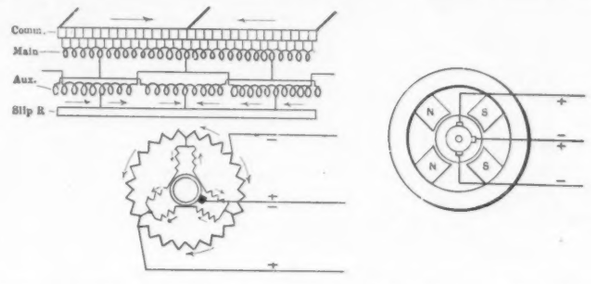


FIG. 3.—LAMME'S MODIFICATION.

The three-wire dynamo of Dobrowolsky is shown in Fig. 2. A choke-coil is tapped into the armature winding at the two points of opposite potential (assuming bi-polar construction), and the center of this coil is connected to the neutral wire. If the choke-coil is mounted so as to rotate with the armature, the neutral is connected to the center of this coil by means of one slip-ring; if mounted in a stationary position, as shown in the diagram, the outside terminals of the coil are connected to the armature through the medium of the two slip-rings and the neutral connection is tapped in solid. The center of the choke-coil is at mid-potential, and any difference in current between the two branches of the system can flow along the neutral and through the coil, which offers no impedance to direct current. The windings of the choke-coil are arranged so that the direct currents in the coil are magnetically opposed, thus avoiding saturation of the core. This feature is only partially accomplished. An alternating magnetizing current and also an alternating core-loss current are present in the coils, and both these currents increase with unbalanced load because it is not possible to completely eliminate unidirectional magnetization.



FIGS. 4 AND 5.—OSANA, AND DETTMAR AND ROTHERT THREE-WIRE DYNAMOS.

Lamme's modification of Dobrowolsky's invention is shown in Fig. 3. It consists in making the slip-ring connection two-phase; there are four slip-rings in addition to the commutator, and two choke-coils connected in "star." The neutral wire is connected to the center of the star. By this means a slight gain is made in the distance the neutral current must traverse the armature winding.

Both of the above machines, while simple in principle, are sufficiently complicated in the connections to render the locating of trouble an irksome task. In addition, the increased length of shaft required for the slip-rings cuts down the saving in floor space, and it is impossible, without added complication and mechanism, to regulate the voltages independently. An admission of this weakness is evidenced by the fact that two large manufacturers have taken out patents on an additional auxiliary device, practically amounting to a balancer, the purpose of which is to regulate the two voltages.

The three-wire dynamo of Osana, which is illustrated in Fig. 4, is provided with an auxiliary winding laid in the same slots as the main winding, usually in the bottom of the slots. Sections of this auxiliary winding are proportioned to develop opposed voltages of half the value of the main voltage. It is tapped into the main winding at the opposed points of connection, and the center of each section is connected to a slip-ring, which is in turn connected by a brush to the neutral. If the conductors of Dobrowolsky's choke-coil were placed in slots on the armature surface and connected so as to develop an e. m. f. equal and opposite at every instant to that impressed on the terminals of the coil by the main winding of the armature, there would be no alternating current in the coil and the magnetizing and core-loss components would not exist. This, in fact, is the embodiment of Osana's machine. It is said that there is no gain without some sacrifice, and the sacrifice in this case lies in placing the auxiliary winding in the armature slots —the most valuable space in a dynamo. On account of the heating of the auxiliary conductors and the increased slot depth required, it is necessary to make the armature of a machine of this type of increased diameter. The old weakness, lack of independent voltage regulation, is common to this machine also. One attempt has been made to overcome the difficulty by mounting the positive and the negative brushes on independent rockers, and supplying means for shifting these brushes independently. In order to regulate the voltages in this manner the machine must be designed with an unusual margin in commutation.

An interesting machine is that of Dettmar and Rothert,

illustrated in Fig. 5. Here a two-pole armature is mounted in a field having four salient poles. Poles of like polarity are situated in juxtaposition, each pair forming a single magnetic pole. In reality, the machine is a two-pole dynamo with a wide gap in the center of each pole. The neutral brush is placed opposite this gap. Armature reaction, even with balanced load, weakens the upper south pole and strengthens the lower south pole; likewise, the lower north is weakened and the upper north strengthened. The result is that the voltage on the positive side of the system becomes lowered and that on the negative side increased. This is overcome by compounding the weakened poles cumulatively and the strengthened poles differentially. This same winding is effective in balancing the voltage automatically. It is also possible, by connecting the shunt field-coils in two independent circuits, to regulate the voltage independently by hand. This machine accomplishes in regulation all that can be done with a generating unit consisting of two dynamos in series. The chief disadvantage is its excessive weight, the yoke and armature core being twice the cross-section of an ordinary four-pole machine. If made with more than four poles, the construction is limited to an even number of pairs of poles.

An objection to all three-wire dynamos is that, in order to compound them so as to deliver the necessary total voltage at any load, the series field-winding must be divided into two circuits, half the total number of coils being connected in series with each main. The connections of the Dettmar and Rothert machine have just been described. In the other machines the series coils are all made cumulative, and coils that are mounted on poles of like polarity are connected in series with one leg and those of the opposite polarity in series with the other leg. To connect from coil to coil in either circuit requires a jumper

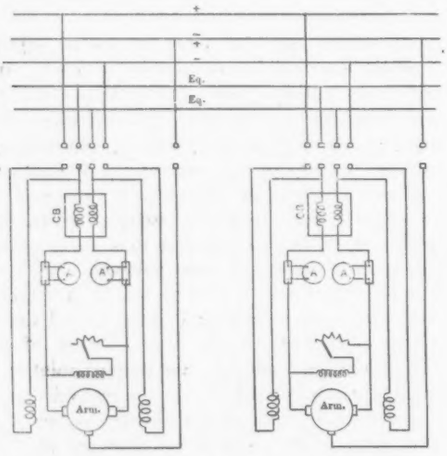


FIG. 6.—THREE-WIRE DYNAMOS IN MULTIPLE.

spanning a complete pole. As stated, this compounds for the *total voltage only* and has no effect whatever in balancing the voltages.

To operate two compound three-wire dynamos in parallel two equalizer bars are necessary, one for each series field-circuit. This requirement entails an additional and expensive feature for the switchboard, and in switchboards of large central stations there would be difficulty in finding room for the extra equalizer. A diagram for multiple operation is shown in Fig. 6. There are six heavy cables of full-load capacity running to the switchboard, and, in addition, there is a neutral cable. In the case of the choke-coil system the coils are often placed back of the switchboard or at some place equally distant from the machine, requiring in this case four small cables leading from the machine. All of these wires are multiplied for every three-wire machine in the plant; the item of expense is considerable, and should not be neglected when comparing different three-wire systems. One might think that four full-current cables would suffice, two for the equalizers and two for the leads. The figure shows that two additional cables leading from the armature are necessary in order to obtain adequate protection for the machine. These two cables lead to the ammeter shunts and the two circuit-breaker coils. An attempt has been made to avoid the use of these two cables by mounting the ammeter shunts on the terminal blocks of the machine and running long lead wire from these shunts to specially-calibrated ammeters on the switchboard. In this case the circuit-breakers are placed in series with the cables leading from the series field-coil. This is not the proper place for a protective device, because it is liable to throw the machine out of service when the armature is not at all overloaded; since the coil of the circuit-breaker might be actuated by the sum of the armature current and an equalizer current from the other machines just at the time when equalization is most needed. In order to get equalization comparable to that of two-wire dynamos, it is imperative to use the six big leads to each machine.

In order to operate a compound two-wire dynamo in parallel with compound three-wire dynamos, it is necessary to split its series field windings into two circuits and supply two equalizers. Standard two-wire dynamos must therefore be remodeled to the extent of a reconnection of the series field coils and the addition of at least one new terminal block for the extra equalizer. Many machines are so built that it is difficult to make these changes without considerable expense; for example, a machine with rectangular poles having the series-coil leads coming out between the poles may require rewinding of the series field coils.

The author stated that the little that is gained over the old Edison system with two separate generators in series by combining two-wire and three-wire dynamos in one plant is more than lost in the inability to regulate the pressures. Another difficulty common to all machines with double equalizers is that, unless the voltages of the two machines are equal before the equalizers are thrown in, a short-circuit of the most violent nature is likely to occur through the armature of the incoming machine, because the equalizers are at the full terminal difference of potential.

A Central Station in Bermuda, West Indies.

A central station recently placed in operation is that of the Bermuda Electric Light, Power & Traction Company, at Hamilton. This is the first central station in Bermuda and contains the largest of the three generators on the island. The difficulties that had to be contended with were peculiar, owing to the difficulty in obtaining coal and supplies, and the lack of a regular

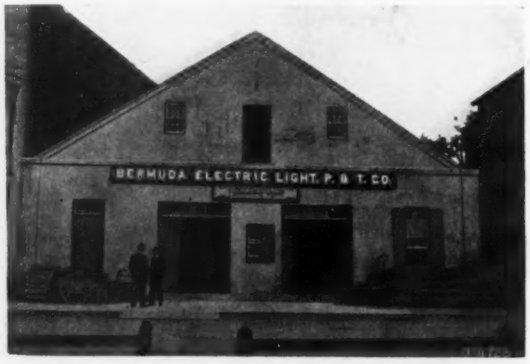


FIG. 1.—EXTERIOR OF HAMILTON, BERMUDA, POWER STATION.

water supply. It was therefore necessary to adopt a system requiring a minimum consumption of coal and a small amount of water. This was successfully accomplished by using a high efficiency gas engine and producing the gas by the Tate process which requires water for scrubbing only.

The power plant is situated on the ground floor of a building 40 ft. x 80 ft. situated on East Broadway, facing the harbor. At present only the rear part of the floor is used for power purposes, the front being occupied as a carpenter shop. An option

is held, however, for the whole building, thus providing ample space for the plant's growth in proportion to business. The building, Fig. 1, is entirely of coral stone with concrete main floor. It is two stories high, having a 20-ft. extension the entire height of the building at the rear. This extension, divided from the main building by a fireproof wall, makes an ideal producer room and will be used entirely as such as soon as additions are made to the plant. At present this extension contains the producer and scrubber, blower, compressor, circulating pump, the gas engine for the generator and an old boiler which furnishes power for the carpenter shop and which will be shortly removed.

The producer plant consists of a 100-hp Otto producer and scrubber using about 1¼ lbs. of coal per hp-hour. The Tate process which is used for gas production requires no gas reservoir or steam. The producer is started by means of a small rotary blower and thereafter the draught is maintained by the vacuum caused by the engine intake. The coal used is anthracite pea coal obtained from New York. The blower for starting the producer and a small compressor for starting the gas engine are driven by a small Otto gasoline engine. This apparatus is run only for a short time in starting up each day.

Water for the scrubber and for the cooling system of the engine is circulated by a pump belted to the main engine. Rain water is depended upon almost entirely, a supply of salt water from the harbor being available in case of drought. This is not likely to occur, however, owing to the heavy annual rainfall in that climate. Drainage from a roof surface of about 10,000 square feet, several buildings, is collected in a 78,000-gallon storage tank situated below the floor of the main building.

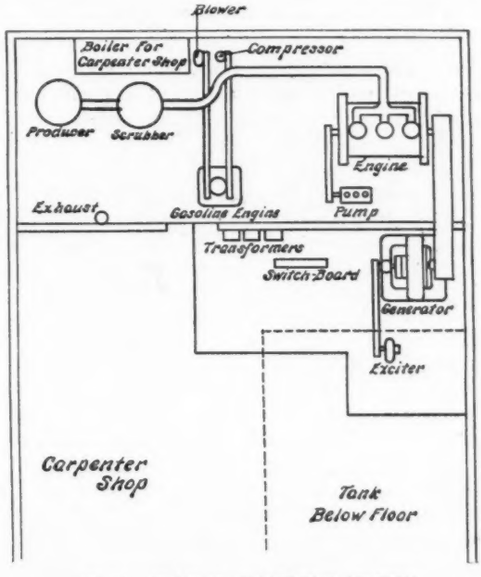


FIG. 2.—PLAN OF HAMILTON STATION.

ing. From this tank water is pumped by means of the circulating pump to a roof tank, from which it descends to the scrubber and the cooling system. The cooling water is returned to the storage tank and re-used and the scrubber water is run to waste. The engine requires a circulation of about 500 gallons an hour and the scrubber about 100. This last is the only water waster.

The main engine is a three cylinder, 75-hp Nash gas engine running at 250 r. p. m. It is belted to the generator in the main building, the belt running through the fireproof wall. The generator, Fig. 3, is a 50-kw, three-phase, six-pole, 2300-volt machine, running at 1200 r. p. m. The adaptability of these machines for parallel operation even with the somewhat variable drive of gas engines, made it particularly applicable for a plant of this kind where early additions are contemplated. The exciter is a 1.35-kw generator belted to the main generator to run at 1450 r. p. m.

When additions are made the boiler will be removed from the producer room and three more producer sets will be installed. The engine and generators will then be installed in the main room. The plant at present supplies a 32-ft. sign containing 163 16-cp lamps on the front of the building, several arc lamps and about 15 incandescents in the building. As soon as the pole lines are completed it is proposed to light streets, residences and stores in Hamilton and later to transmit to distant points. The plant was installed under the direction of Mr. W. F. Hurlbutt, erecting engineer of the Crocker-Wheeler Company, which company supplied the electrical equipment.

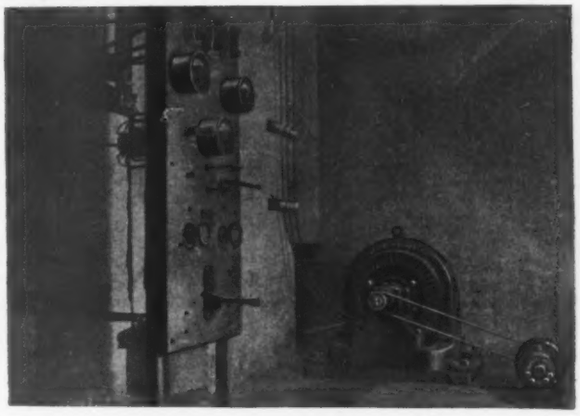


FIG. 3.—INTERIOR OF HAMILTON, BERMUDA, GENERATING STATION.

LETTER TO THE EDITORS.

Simplified Spelling.

To the Editors of Electrical World:

SIRS:—Referring to the letter of Prof. Brander Matthews in your issue of June 8, I am glad to know that you intend to "adhere to the spelling which has the sanction of general good usage." Prof. Matthews says, "Good usage varies widely and no two dictionaries agree." I should say, however, that when two modern dictionaries do agree on a certain word that it should be considered good usage, and if another dictionary stands by itself in spelling a word differently, that should be considered bad usage. The "Standard" dictionary may be somewhat in advance of the "Century," but it has made an advance in the direction of confusion, and it ought to take a step backward in its next edition. Several newspapers are following the "Standard" dictionary now and are spelling "practice" *practise*, both noun and verb, instead of "practice," the older form for both, or "practice," noun, and "practise," verb. It has been the custom as long as I can remember for physicians, lawyers and doctors to speak of their "practice," and all the literature in relation to their practice spells it with a *c*. Why should we now spell it with an *s*, just because the "Standard" dictionary spells it that way, while "Webster" and the "Century" do not? I have an old edition of "Noah Webster," which has the following:

"Practise, v. t., i.—See practice. (There is no reason why the noun and verb should not both be spelled with c, as in notice, sacrifice, apprentice, and all like cases where the accent precedes the last syllable. The distinction in spelling between the noun and verb properly belongs only to words which are accented on the last syllable, as device and devise, where the verb had the sound of ize. The spelling practise tends to give it the same sound, as we see in uneducated persons; and hence it is desirable to follow the regular analogy and write the noun and verb alike.)"

That was good advice given by Webster, and I do not see any reason for not following it now.

As for the simplified spelling of the committee, I am willing to go just as far in the direction of cutting off useless letters as "Webster" and the "Century" dictionaries go, but not a step farther. I strongly object to having one word *mist* mean both a fog and the past tense of "miss," and to have the past tense of the verb "to pass" spelled like the adjective *past*. I have a particular antipathy to *thru*, for this reason: Nine people out

of ten still use the pen and not the typewriter. Eight out of these nine write the letter *n* just like a *u* and four out of the eight write the letter *r* like some other people write the letter *e*. Some people will write what they think is *thru* and it reads *then*, and they will write *then* and it reads *thru*. If we could get everybody to write the letter *e* in the good old-fashioned way with a loop like a shortened *l*, this trouble would not arise, but so many try to write the small letter *e* similar in shape to the capital letter and so make it look like an *r*. In penmanship, the most desirable quality is legibility. If a man is a very bad penman he can scarcely write "through" so badly that it cannot be read, or at least guessed at, on account of the *gh* at the end, but even a fairly good penman may write *thru* to look like *then*.

Syracuse University. Wm. Kent.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Electric Drying of Insulation of Transformers.—H. W. Turner.—In a place in Italy where insulation difficulties on some air-cooled transformer coils were experienced, and where steam for heating the drying ovens was not available, while coal was very high priced, coke was employed for this purpose, with the result that the temperature of the ovens fluctuated with the firing to a very wide extent. Insulation troubles, due to insufficient baking and hardening of the insulation varnishes, were overcome by adding ventilating fans to supply fresh air for oxidizing and hardening the varnish. The oven temperature was raised and kept more uniform by the aid of automatic temperature recorders and the varnishes were thinned to a better working density. The following system of electric drying was found to be quite effective. A motor-generator set was installed in the winding department from which direct current was supplied to the transformer coils which were being insulated. The coils had already been given a first dipping and been oven-dried over night so that the insulation and varnish next to the copper was perfectly dry and hard. The coils were connected six in series and sufficient current passed through them to keep the temperature, as registered by thermometers placed on the coils between 80 and 90 degs. C. Bias-cut treated linen tapes were used instead of cotton tapes and insulating varnish was applied immediately after each layer of tape. Two men put on the tape and applied the varnish consecutively to each of the coils. As soon as the last coil of the series had been taped and varnished the first one was dry enough for the next layer of tape and varnish. In this way several layers of tape could be applied in a day, so that instead of eight weeks less than one week was required for this work. In addition there was another great advantage, as the finished coils were at least 12 mm thinner than by the old method, thus allowing more air ventilating space between the coils when installed. The result was a considerable saving in time, labor and material so that two of the four drying ovens were permanently shut down.—*Elec. Jour.*, July.

Field Regulation of Alternators.—A note on a recent (British) patent of Ganz & Company for regulation of alternators. The pressure is regulated according to the load by including a resistance of negative temperature coefficient in the continuous-current field circuit, or a resistance of positive temperature coefficient in connection with the field of the exciter, these resistances carrying a current dependent upon the pressure and the load on the machine and influencing the current through the fields of the exciter so as to control the excitation to the main machine. In Fig. 1 the polyphase generator *G*, has continuous current field magnets *F*, energized by an exciter with an armature *g*, and shunt field-winding *f*. A counter winding f^1 in series with the positive temperature-coefficient resistance *W* is connected in shunt to the field winding *f*. The resistance, *W*, is traversed by the continuous shunt current in the counter winding *f*, and by an alternating current depending upon the load and the voltage of the main generator, and obtained, for example, from two small transformers, *i* and *v*, connected respectively in shunt across the terminals of the main machine, and in series with it, the secondaries being connected in series to the resistance *W*. The connections of the two coils, *v* and *i*, are such that the currents in them are in quadrature. If the load on the main generator, *G*, increases, the current through the secondaries increases, causing the resistance of *W* to increase so that the current through the counter winding f^1 is weakened, and the excitation of the exciter correspondingly strengthened. The resistance, *W*, can be arranged in shunt across the field winding *F*, of the alternator in series with a counter winding arranged upon the

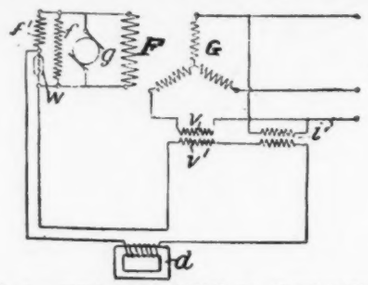


FIG. 1.—FIELD REGULATION OF ALTERNATORS.

field winding, *F*. A resistance of negative temperature coefficient may be connected in shunt. To equalize fluctuations of pressure produced by alternations of frequency, a self-induction coil, *d*, may be switched into the circuit of the transformer coils, *i v*.—Lond. *Elec. Eng.*, June 28.

Magnetizing Current of Polyphase and Single-Phase Windings.—W. Kummer.—On the basis of a recent paper of Georges on the vector diagram for the field strength for calculating the e. m. f. of polyphase and single-phase windings, the author determines the magnetizing currents of such windings and compares these results with calculations made on the basis of the resolution of the rotary field into harmonics. It is shown that all numerical values found by both methods agree with each other.—*Elek. Zeit.*, June 27.

Resonance Transformer.—C. Breitfeld.—An article on the theory of the resonance transformer—that is, a transformer which contains a condenser in the secondary—without some of the simplifying assumptions which had been made in former investigations of this subject.—*Elek. Zeit.*, June 20.

Power.

Turbo-Generator Tests.—An article giving the results of tests made by H. G. Stott on the 5500-kw turbo-generator at

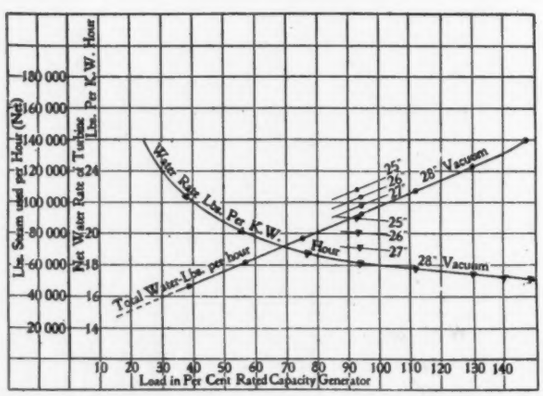


FIG. 2.—TURBO-GENERATOR TESTS.

the power house of the Interborough Rapid Transit Company in New York. The two most important relations to be de-

termined were the variation of steam consumption with load (constant thrust-bearing settings) and the variation of water rate with vacuum (constant load 5000 kilowatts). The results of the tests are given in Fig. 2. The operating record for the year 1906 is also given in the table. During 65 per cent of the time the turbine was in operation and carried an average load of 2 per cent above rating, while during the month of December it averaged 13 per cent above rating. The total output for the year was 32,054,250 kw-hours. For five different periods of 10 days under continuous load, the turbine averaged 140,422 kw-hours per day. Comparing this with the economy of a large Corliss engine with an assumed mechanical efficiency of 91 per cent, the engine would have to show an equivalent water rate of close to 10 lbs. per hp per hour to equal the performance of this turbine.—*Elec. Jour.*, July.

Power Transmission in Paris.—BLONDEL, HARLE AND MAEHL.—A long report on the project of power transmission from the Rhone district, where abundant water power is available, to Paris. The estimate refers to a plant which could furnish per year 1,010,000,000 kw-hours. The project considers in the first place direct-current transmission at 120,000 or 160,000 volts, but they may decide to use three-phase current transmission.—*L'Industrie Elec.*, June 25.

Direct-Current Power Transmission.—A critical discussion of the recent paper by Highfield on the direct-current high-tension series system of Thury. The anonymous author sums up the disadvantages of this system, compared with polyphase transmission, and concludes that the direct-current series system has no promising future for power transmission.—*Elek. und Masch.*, June 23.

Electric Power in Sewage Works.—An illustrated description of the use of electric power in the Hanley sewage works where electricity is used for driving the sewage distributers by induction motors and for lighting.—Lond. *Elec. Eng.*, June 21.

Single-Phase Traction.—L. LICHTENSTEIN.—The author gives an account of experimental tests made by the Siemens-Schuckert Company on a track of the Marienfelde-Zossen road. The principal object of the experiments was the determination of the alternating-current resistance and of the "equivalent permeability" of the rails for different currents and frequencies. "Equivalent permeability" is that value of the permeability which is to be used in Maxwell's formula for the self-induction of a loop, in order to get accurately the self-induction of the loop formed by the copper trolley wire and the iron rail. The chief results of these measurements are given in the following table:

Frequency.	Amperes.	R_1	R_2	Equivalent Permeability.	
58.5	49	4.34	4.65	8.0	Joints with Copper Bonds.
48.7	153.8	5.55	6.3	7.2	
28.2	62.5	2.85	3.05	14.8	
25.4	108.4	3.76	4.1	15.0	
19.4	36.4	2.5	2.65	16.	
17.3	123.2	2.93	3.23	19.3	
58.6	35.	2.68	4.84	9.6	Unbounded Joints.
48.6	152.	3.42	6.05	8.6	
28.4	46.2	1.94	3.05	11.0	
25.7	169.	2.2	3.65	14.4	

In this table R_1 is the ratio of the alternating-current resistance of the track per km to the direct-current resistance of the track per km, while R_2 is the ratio of the alternating-current resistance of the rail iron per km to the direct-current resistance of the rail iron per km. Besides these tests, measurements were made of the conduction of current through the earth, the resistance between earth plates, the tension of the rails against earth, the influence on telephone and telegraph circuits in the neighborhood and various capacity determinations.—*Elek. Zeit.*, June 20 and 27.

Single-Phase Railway in Italy.—A note on a single-phase electric railway in Italy which is stated to have all the characteristics of an ordinary railway. It is already open for merchandise for a length of 18½ miles, passing in its journey through 17 tunnels and crossing three large bridges constructed across the River Brembo at different parts of the route. Vignoles rails are employed weighing 27½ kg per metre, or about 56 lbs. per yard. Besides the two terminal stations, there are seven intermediate stations, all of which are provided with sidings for goods traffic. The levels vary from 810 ft. to 1300 ft. above sea level. The maximum gradient is 2.4 per cent for a length of 2300 ft., and there is a large number of curves, the minimum radius being 490 ft. The single-phase energy is supplied at 6000 volts. Throughout the entire length of the line the overhead conductor is erected, together with a feeder of 0.3 in., two wires each of 0.15 in. for supplying light to the stations, and a telegraph line. The trolley wire is supported by a steel cable composed of seven wires, each of 0.075 in. in diameter, suitable for a tension of 5500 lbs. The copper conductor attached thereto has the form of the figure 8 rolled to a section of 0.078 sq. in. Numerous methods of support are adopted along the line; in many cases 2½-in. channel iron is supported on either side of the line by wooden posts, and to it the steel cable is attached. The insulators used have been tested, when dry, to 50,000 volts, and in abundant rain to 15,000 volts. They consist of concentric bobbins slipped one over the other. The poles used are generally 6½ ins. at the top and 32 ft. long, 5 ft. 9 ins. being put in the ground. The lower ends are treated with creosote and chloride of zinc. The generating station is about one mile from Santa Giovanni Blanco, on the left bank of the Brembo. Three Riva-Monneret electric generators, coupled direct to turbines, are installed, each of 500 kilowatts at 500 revolutions, and for 25 periods. Separate exciting machines are installed, each of 30 kilowatts at 125 volts and 1000 revolutions, each of these again being coupled direct to turbines. Each locomotive is provided with four single-phase motors, each of 75 horse-power, suitable for a voltage of 250; each motor operates through gearing one axle of the motor truck. At the base of the locomotive a lightning arrester is located. Five of these locomotives have now been at work for the last few months drawing trains up to 175 tons, and notwithstanding the heavy gradients, an average speed of 12¼ miles per hour, including stops, has been obtained with a maximum speed of 34 miles.—From *L'Elettricita;* abstracted in Lond. *Electrical Engineer*, June 28.—An illustrated description, by A. Soulier, of the same railroad in *L'Industrie Elec.*, June 25.

Power in Denmark.—An illustrated article on the recently opened generating station of the Tuborg-Klampenborg Tramway Company at Skovshoved, near Copenhagen, which is the first alternating-current station in Denmark and forms the nucleus of a power transmission system. The station contains at present two direct-current dynamos, each of 150 kilowatts, supplying the traction current and also a pair of 150-kw motor generators, which convert to three-phase currents at 10,000 volts for supply to the power feeders. A battery is in parallel with these motor-generators. There are now being installed a pair of turbo-alternators, each capable of an output of 500 kilowatts, three-phase. When these turbo generators are running the two motor generators will be used in the opposite way; that is, to convert from 10,000-volt alternating to 550-volt direct current so as to supply traction current when the direct-current generators are shut down. About 10 miles of transmission line have been laid down to 14 transformer substations, the transmission voltage being 10,000. For further extensions it is intended to install two turbo-generators of 1200 kilowatts, and three sets each of 2500 kilowatts, all generating directly alternating current at 10,000 volts.—Lond. *Elec. Eng'ing*, June 13.

Electric Drive.—A fully illustrated description of the use of electric power in the Sheffield works of Vickers, Sons & Maxim. Every machine is being run at the highest possible speed for the work in hand and the introduction of high-speed tool-steel simultaneously with electric driving has increased the output of some of the shops by 100 per cent. Variable speed motors are employed, giving in most cases a range of speed of 3 to 1 simply by varying the shunt excitation, and whenever possible speed cones and back gear have been dispensed with. One of the shaping machines in use has a speed range of 6 to 1, from 1200 to 200 r. p. m.—Lond. *Elec. Eng'ing*, June 20.

Pumping.—C. Hawksley and H. Davey.—A paper presented before the recent Engineering Conference of the British Institution of Civil Engineers on comparative costs of pumping by steam, internal-combustion engines and electricity based upon actual work, together with the discussion which followed.—Lond. *Elec.*, June 21.

Installations, Systems and Appliances.

Neutral Currents of a Three-Phase Grounded System.—G. I. Rhodes and C. F. Scott.—A paper, by G. I. Rhodes, illustrated by numerous oscillographic curves, on the effect of harmonics in three-phase circuits, with an editorial discussion on the subject by C. F. Scott. The fundamental and the third harmonic have quite different characteristics. One connection of circuits is impervious to the harmonic, although freely admitting the fundamental, while another connection allows the harmonic current to flow without the fundamental. The 5000-kw generators described in the present article generate similar e. m. f. in each of the three branches of the armature winding, which are connected in the ordinary star form. The e. m. f. measured between the neutral point and either of the main terminals of the generator contains both the fundamental and the various harmonics. The e. m. f. measured between the main terminals of the generator, and therefore including in series the e. m. f. generated in two of the branches of the armature winding, contain the fundamental and certain harmonics, but others do not appear for the reason that they oppose one another in the two branches; or, in other words, the third harmonics (and those which are a multiple of three) tend simultaneously towards the central or neutral point in all three branches. The two three-phase generators being connected in parallel on three bus-bars; the third harmonic does not appear in the bus-bar e. m. f. It does occur, however, in the e. m. f. measured between a neutral point and either bus-bar. If the two machines are operated under exactly similar conditions, there is no occasion for current to flow between the neutral points. If, however, the two generators have third harmonics of different value, then the e. m. f.'s between the neutral and the three main terminals of the first generator do not correspond with those in the second generator. Each of the three branches of one generator is in parallel with one of the three branches of the second generator. These three circuits have a common connection in the conductor, connecting their neutral points. Consequently, it affords a path for the currents which tend simultaneously to flow toward the center in all three circuits. If, therefore, the third harmonics in the two machines are not quite equal, the current flows in each of the three branches of the winding through the neutral conductor from one generator to the other and returns through the three bus-bars. The conditions which give rise to unequal third harmonics are due to field distortion caused by the armature current. If the armature currents in the two machines are similar, then the e. m. f.'s generated will be similar. If, however, the armature currents are not similar, for example, if the load on one machine is large while that on the other is small, or if the currents delivered are of different phase, or if there is a local current of fundamental frequency flowing between the machines, which is therefore leading in one machine and lagging in the other, then the field distortion and the e. m. f. produced are not the same in the two machines. A connection between the neutral points allows these unequal e. m. f.'s to cause a flow of current at three times the normal frequency. This current returning through the bus-bars affects the form of the bus-bar current. This high-frequency current, however, does not get beyond the bus-bars to the load if there be no connection between the neutral point of the generators and the load. In the present case, the 5000-kw generators run well in parallel under various conditions of load, excitation and engine conditions when the neutral points are not connected together, but encountered difficulties when the neutral points are connected and the conditions in the individual machines are materially dissimilar. Fortunately, however, it was found that the protection sought could be secured by the grounding of the neutral of a single generator instead of all of the generators in parallel, as was at first proposed.—*Electric Jour.*, July.

Storage Batteries in Alternating-Current Networks.—Notes on some recent British patents of Siemens Brothers & Company. One of them relates to the regulation of alternating-current circuits by means of automatically-operating buffer devices. An alternating-current booster is interposed between the main leads and the rotary converter and buffer battery employed. The field of the booster is excited by a current which varies with the load on the network, and may also be dependent upon a current derived from the storage battery. In the arrangement shown in the lefthand diagram of Fig. 3, the

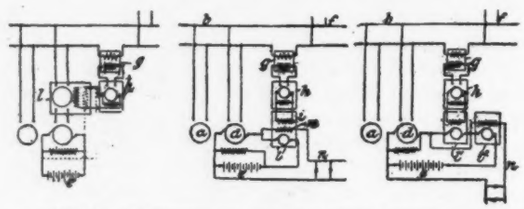


FIG. 3.—STORAGE BATTERIES IN ALTERNATING-CURRENT NETWORKS.

excitation of the booster, *l*, is effected through the series transformer, *g*, and the auxiliary rotary converter, *h*. In a modified arrangement, the excitation is effected by means of a current from the battery, *e*, the current being regulated by a variable resistance controlled by a solenoid carrying a current proportional to the network load. A second patent (see middle diagram) describes a means for reducing fluctuations of current in an alternating-current network, *f*, by a buffer battery, *e*, in parallel with the alternating-current generator, *a*, for the case in which the battery is also utilized to feed a direct-current network, *n*. The rotary converter, *d*, is provided with a booster, l^1, the field excitation of which varies according to the currents traversing both networks. One part of the field winding, *i*, is fed from a rotary converter, *h*, which in turn is fed from a series transformer, *g*. The other part, *m*, carries a current proportional to the current through the network, *n*. A modified form (see the righthand diagram) has two separate boosters, l^1, l^2, in series, the respective windings of which differ like the respective parts in the first modification.—Lond. *Elec. Eng.*, June 21.

Efficiency of Alternating-Current Plant with Storage Battery.—L. Schroeder.—With reference to a recent description of a three-phase plant, in connection with which a storage battery is used, the author determines the different losses which occur and finds that for full load the efficiency of the total plant, including the storage battery, is 89 per cent.—*Elek. Zeit.*, June 20.

Draught Regulator for Boiler Plants.—A note on an electric device for automatically regulating the air inlet to boiler furnaces. As shown in Fig. 4, it consists of a perforated pipe,

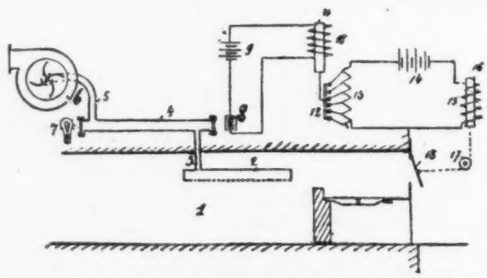


FIG. 4.—DIAGRAM OF DRAUGHT-REGULATING APPARATUS.

2, fixed in the flue, 1, behind the grate, and connected to the chimney through the tube, 4, and the small fan, 6, so that a portion of the flue gas passes along the tube 4. This tube is 4 cm or 5 cm in diameter and 1 m long, and is closed at both ends by transparent mica plates. An incandescent lamp, 7, is arranged at one end of the tube, and serves to throw more or less light on to the selenium cell, 8, according to the smokiness of the flue discharge. The selenium cell forms part of

the battery circuit, 9, which also includes the relay solenoid winding, 10. The solenoid core, 11, is drawn up more or less, and varies the resistance in the circuit of the main battery, 14, and so controls the position of the air damper, 18, by means of the solenoid, 16. If desired, the selenium cell may be replaced by a bolometer arrangement.—Lond. *Elec. Engineer,* June 28.

Wire, Wiring and Conduits.

Electric Cables for Collieries.—G. G. L. PREECE.—A paper, read before the Manchester Geological and Mining Society, on two improvements for electric cables for coal mines. In the first place he describes a method of filling up the interstices between the wires of a stranded copper conductor with a special solid compound which will not run or become displaced by the heating of the conductor through overload. The method is to cover the center wire, and each succeeding layer of the stranded conductor, with a thin tube of plastic bituminous compound. This compound gets thoroughly worked up into the interstices of the strand. The principal advantage is that all passages for moisture are said to be stopped. The second improvement described by the author is a new construction of a three-core bitumen cable for three-phase currents, as shown in Fig. 5. The conductors of this cable are

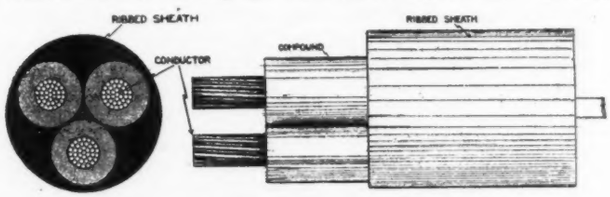


FIG. 5.—SECTIONS OF BITUMEN CABLE.

each separately insulated with bitumen compound, then laid up together round a shaped core of bitumen, which fills up the central space, and is sheathed over all with a solid tube of bitumen, which is so forced on as to be ribbed internally and exactly fit the interstices between the three cores. The cable can then be taped and protected by armor, etc., as is necessary. This special construction obviates the introduction of fibrous material as padding.—Lond. *Elec. Eng.,* June 21.

Fuse Wires.—F. EMDE.—A highly mathematical paper discussing the phenomena during operation of a fuse wire.—*Elek. und Masch.,* June 16 and 23.

Electrophysics and Magnetism.

Experiments with Vacuum-Gold-Leaf Electroscopes.—J. T. BOTTOMLEY AND F. A. KING.—A description of some striking mechanical effects which the authors observed in the gold leaves of vacuum electroscopes and which, at first sight, might be taken to simulate electrification of bodies by light and radiating heat falling on the gold leaves. The present account of the experiments is only a preliminary one.—*Phil. Mag.,* June.

Electrons and Ether.—A highly theoretical paper by C. B. Burton giving notes on ether and electrons; a note by A. H. Bucherer on the action of uniform electric and magnetic fields on moving electrons; and a note by Oliver Lodge on the ether and on the hypothetical magnetic flow.—*Phil. Mag.,* June.

Electrochemistry and Batteries.

Corrosion of Iron as an Electrochemical Phenomenon.—A. S. CUSHMAN.—An abstract of a paper read before the American Society for Testing Materials. In the rusting of iron, oxygen is not the primary cause; its rôle is only secondary. When iron rusts there is first dissolving of iron in moisture, if the latter in contact with the iron contains hydrogen ions. The iron thereby passes into the state of ferrous ions and is later on oxidized by the oxygen in the air to ferric, with the resulting precipitation of the insoluble red hydroxide known as rust. Rusting may be prevented if the occurrence of hydrogen ions in solution in contact with the iron is prevented. This is stated to be possible by treating the iron in a potassium bichromate solution, which brings it into the condition of an oxygen electrode. The same issue contains a paper by W. H. Walker on the effect of stress upon corrosion of iron. Both papers are discussed in a long editorial.—*Electrochem. and Met. Ind.,* July.

Electric Steel.—A profusely illustrated description of a steel plant using the Héroult process for making steel of crucible steel quality. The metallurgical features of the Héroult process are also dealt with. The process consists first in the making of steel in the open-hearth furnace whereby the phosphorus is reduced to any desired extent; the overoxidized and decarbonized metal is then introduced in molten state into the electric furnace where the sulphur is eliminated and the metal is deoxidized and recarburized.—*Electrochem. and Met. Ind.,* July.

Storage Batteries.—V. KARAPETOFF.—A second article in which the operation and control of storage batteries are discussed. The author deals with the selection of the system of control; charging two halves of a battery in parallel; charging batteries in sections; the use of end-cell switches, and end-cell switch control of storage batteries.—*Elec. Jour.,* July.

Ozone.—A. W. EWELL.—An illustrated account of a test of an ozonizer the construction of which is shown in diagrams. The efficiency curves of the production of ozone are given.—*Electrochem. and Met. Ind.,* July.

Carbon Tetrachloride.—J. R. CROCKER.—An illustrated article on the manufacture of carbon tetrachloride from electrolytic chlorine and on the uses of the tetrachloride.—*Electrochem. and Met. Ind.,* July.

Units, Measurements and Instruments.

Measurement of Mutual Inductance.—A. CAMPBELL.—An abstract of a (British) Physical Society paper. Carey Foster's method of comparing a mutual inductance with a capacity is one of the most convenient methods, and the formula is very simple, being $M = K R r$, where K is the capacity and R and r are resistances. The great advantage gained by the use of a vibration galvanometer in methods for measuring inductance led the author to apply it to the Carey Foster and the Hughes-Rayleigh methods. He found, however, that with alternating currents it was necessary to modify the Carey Foster method by adding a series resistance in the condenser branch; this left the formula $M = K R r$ unaltered and gave an additional formula involving the ratio of a mutual and a self-inductance. The modified method is extremely convenient, the two adjustments required for a balance being independent and the result not involving a knowledge of the frequency; the use of the vibration galvanometer is a great improvement, making the method independent of the wave-form of the current used. If the detecting instrument used in a zero method (with alternating current) is adjusted so that its natural period is in tune with that of the applied voltage, it will be set into strong resonance and will be enormously increased in sensitivity for this particular frequency, practically ignoring in comparison all the other components of the wave-form. The author exhibited a vibration galvanometer having a moving-coil controlled by an adjustable bifilar suspension. By adjusting the tension of this the tuning is very easily effected. For measuring the frequency to which a tuned instrument is responding, it is convenient to use the Hughes-Rayleigh method, in which a known self-inductance is compared with an unknown mutual inductance, the balance being dependent on the frequency. The author showed such an arrangement in which the slide-wire was graduated directly in frequency. With accurately known frequency, on the other hand, the method gives absolute values of L and M.—Lond. *Elec. Rev.,* June 21.

Testing.—V. W. SHEAR.—Some notes of a general character on testing. The author recommends strongly to make diagrams of all circuits on switchboards, tables, relays, etc., which are not in plain sight. A good tester never anticipates results, though it is his chief temptation.—*Elec. Jour.,* July.

Telegraphy, Telephony and Signals.

Tuning in Wireless Telegraphy.—I. HETTINGER.—In an article entitled "Wireless Telegraphy: A Solution of the Problem of Selectivity," the author describes a method based on the

following principle. The ratios of any two or more values of the resonance curve corresponding to different free frequencies of the receiving oscillatory circuits do not substantially change whatever the absolute value of the energy received might be. The author concludes that he has therefore a method of selectivity which is substantially independent of the power and distance of transmission. Several methods of applying this principle are described.—Lond. *Elec. Eng.*, June 21.

Speaking Condenser.—P. Seve.—A paper on the speaking condenser of Argyropoulos and Deprez. The author explains why the production of speech by means of an "electrostatic" telephone can only be counted upon when a strong auxiliary e. m. f. is applied to the condenser. When the primary e. m. f. obeys the equation $e = a \sin b\,t$ the attraction between the condenser plates is proportional to $\sin^2 b\,t$, and is, therefore, always positive, though intermittent. This means that musical notes will be rendered an octave higher than they are given. The circumstance makes no essential difference to a musical piece, but has the effect of seriously distorting spoken words, as one can verify by running a phonograph at twice the speed of the original record. The device of Argyropoulos makes the attraction practically proportional to $\sin b\,t$, and therefore reproduces all tones in unison. The author quotes an experiment made with an electrostatic telephone with and without an auxiliary e. m. f. Without it the notes 34 and 1000 were given, whereas with an auxiliary 270 volts the original pitches 42 and 500 were correctly rendered. The principle is really the same as that adopted in the heterostatic voltmeter and the telephone with polarized cone.—*Comptes Rendus*, June 3; Lond. *Elec. Eng'ing*, June 20.

Railway Signals.—W. E. Foster.—In a continuation of the illustrated serial on railway signals, the principles of automatic block signaling are discussed.—*Elec. Jour.*, July.

Induction Type Ammeters, Voltmeters and Wattmeters.

By Paul MacGahan and H. W. Young.

To the consulting engineer, central station manager and in fact practically everyone connected with electrical development, the subject of alternating current measurements is one of much importance. The ammeters, voltmeters and wattmeters described below all operate upon the "Induction Principle," depending for their action upon the generation of a torque or turning moment in a pivoted metallic shell located within the influence of a rotating magnetic field energized by the current to be measured.

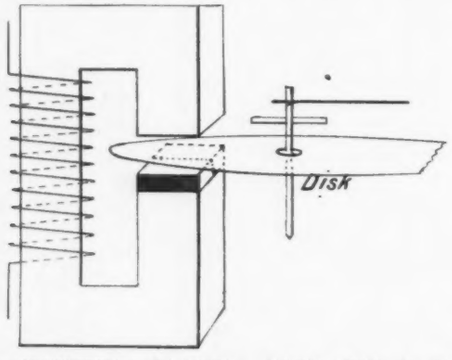


FIG. 1.—ARRANGEMENT OF PARTS. EARLY FORM OF INDUCTION AMMETER.

INDUCTION TYPE AMMETERS.

In order to clearly understand the principle upon which the modern induction ammeter operates it is necessary to take up the simplest form of moving disk meters of which the present drum type are a development. Such a device consists of an electromagnet wound on a laminated iron core of C section (Fig. 1) in the air gap of which rotates a disk-shaped armature suitably pivoted and controlled by a spring in the usual manner.

In order to produce rotation, one-half of one iron pole is surrounded by a short-circuited conducting loop which acts to displace the flux enclosed within itself relative to the flux of the non-enclosed section of the iron pole face. This displaced enclosed flux reacts upon the eddy currents induced in the disk by the other flux and produces a tendency to rotation which is counterbalanced by the restraining action of the control spring.

The effect on the disk and consequently the deflection will be proportional to the strength of the magnetic field (or approximately to the magnetizing current of the coil) multiplied by the current induced in the disk, which latter is proportional to the induced voltage produced by the strength of the magnetic field and the rate at which it varies; hence, the pull on the disk will be proportional to the square of the current and to the frequency of the circuit. As the resistance of the disk varies directly with the absolute temperature, the pull or rotative action on the disk will vary inversely as the absolute temperature.

To overcome the influence of change in frequency of temperature a compensating device has been employed consisting of coils of copper wire wound non-inductively and connected in parallel with the actuating magnetizing coils. As the frequency increased the compensating coils took more of the current, and as the temperature increased they took less, thus compensating in quite a satisfactory manner for the errors introduced by variations in temperature and frequency. This, however, was at the expense of efficiency and torque and the windings were more or less complicated, so that efforts were made to develop a design which would be inherently independent of such variations. The result of these efforts is the development of the "Drum Type" ammeters, voltmeters and wattmeters herein described.

Fig. 2 illustrates diagrammatically the ammeter construction, the various elements of which are as follows: *A*, laminated iron structure; *B*, laminated iron core; *C*, annular air gap; *PC*, primary coils connected in series or parallel; *SC*, secondary coils connected in series or parallel; *AC*, auxiliary coils connected in series with *SC*.

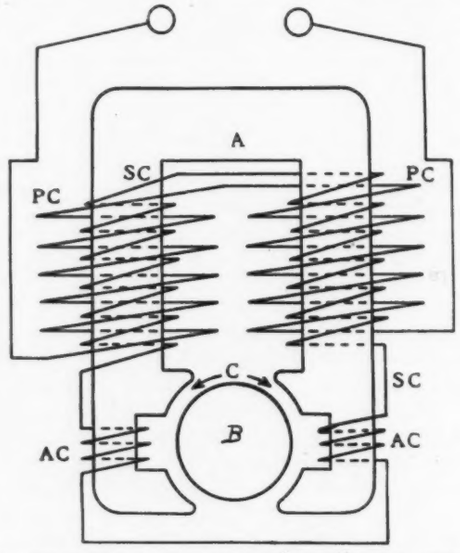


FIG. 2.—ARRANGEMENT OF PARTS. "DRUM" TYPE INDUCTION AMMETER.

The winding *SC* is placed next to the iron laminated core *A*, and the winding *PC* placed over *SC*. The primary windings *PC* actually consist of four coils (Fig. 3), two coils being placed on each leg of the iron laminations. One coil on each leg is connected in series with a coil on the opposite leg, thus giving two series windings in the meter, each winding having half its turns on each set of iron laminations, resulting in a

balanced magnetic circuit. The meters are provided with two heavy binding posts and four smaller posts. When it is desired

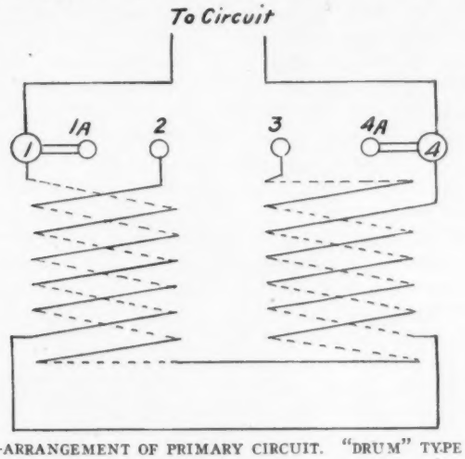


FIG. 3.—ARRANGEMENT OF PRIMARY CIRCUIT. "DRUM" TYPE INDUCTION AMMETER.

to use the lower ampere capacity the windings are connected in series by bridging the two central binding posts, and when it is desired to use the higher ampere capacity the windings are connected in parallel by bridging together binding posts 1*A* and 2 and 4*A* and 4. The circuit leads are connected to the large binding posts.

The moving element consists of a light aluminum cylindrical shell mounted on a shaft provided with highly polished steel pivots, and is located in the annular gap *C*. The shaft, which is supported in jeweled bearings, also carries an indicating pointer and a control spring, the outer convolution of which is fastened to a stationary support.

The meter action can best be understood by considering the windings *PC* and *SC* as the primary and secondary windings respectively of a series transformer, the secondary of which is short-circuited on itself and the primary connected in series with a suitable load. To obtain an induction ammeter system of this kind inherently correct, it is obviously necessary to make the induction vary inversely as the frequency and directly as the temperature. Such a system can be secured in a simple, automatic manner without any corrective devices in the series transformer with a non-inductive copper resistance secondary.

Assuming the current in the primary to be constant, the secondary current will be approximately constant. Thus as the frequency increases, the induction will decrease in direct proportion. Also as the temperature and consequently the resistance of the secondary coil increases, the induced voltage and consequently the induction increases proportionately. If, therefore, the magnetism of the series transformer is made to drive the rotor of an induction meter, the meter will, within wide limits, be theoretically independent of frequency and temperature.

In the simple vector diagram of a series transformer (Fig. 4) let *OS* represent the secondary ampere-turns when the resistance of the secondary is entirely ohmic. Then neglecting losses, *OP* (the primary ampere turns) will equal *OS* and

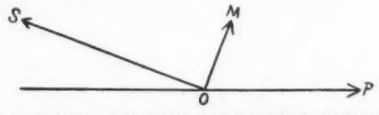


FIG. 4.—VECTOR DIAGRAM OF SERIES TRANSFORMER.

will be approximately 180 deg. out of phase, the angle *SOP* depending upon *OM* which represents the magnetizing current required. The resultant magnetic flux produced will be in phase with *OM*.

The current *OS*, instead of passing through a non-inductive secondary winding can be made in turn to magnetize a portion of the magnetic circuit, in which case the magnetism it produces will be in phase with this secondary current, or in the direction *OS*. The more nearly perfect the device, considered as a series transformer, the more nearly will the two fluxes of *OM* and *OS* be at right angles. In order to have a perfect rotary field, it is only necessary to properly place the coils *OP* and *OS* with reference to each other.

The series transformer principle can be made to serve the double purpose of producing a rotating field without using a "phase splitter" and of producing a field which, in conjunction with a proper rotor, will produce a torque independent of the frequency and of the temperature, within wide variations. It is also found that by keeping the induction and losses very low, variations in wave form produce no appreciable effect whatever upon the torque. These principles, when properly applied to a meter, produce a device which is practically ideal.

The construction employed gives an electromagnet having a rotating field within which is pivoted a rotable closed secondary, the two producing a torque or turning movement which is opposed by the restraining spring, and the point of equilibrium will be indicated by the pointer which affords, in conjunction with a suitably graduated scale, an accurate means of measuring the current value producing the deflection.

VOLTMETERS.

Voltmeters employ the same construction as ammeters with the exception of the primary winding, *PC*, which has a large number of turns of fine wire in series with an internal resistance of zero temperature coefficient. In order that the voltmeter may be used upon either 25 or 60 cycle circuits it is provided with taps in the series resistance brought out to two plug connections. By using the proper tap the meter will read correctly on either frequency.

WATTMETERS.

Fig. 5 illustrates diagrammatically the single-phase wattmeter construction which, as will be noted, has the same general appearance as the ammeter. The arrangement and distribution

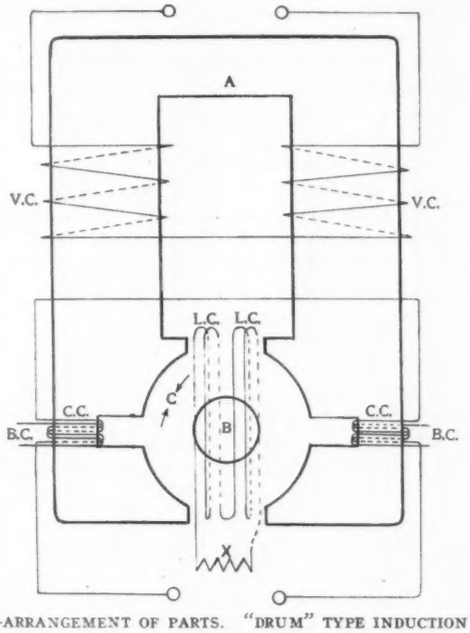


FIG. 5.—ARRANGEMENT OF PARTS. "DRUM" TYPE INDUCTION WATTMETER.

of the windings, however, are entirely different, as the transformer principle is not employed, the rotating field being obtained as in an induction motor.

The various elements shown are as follows: *A*, laminated iron structure; *B*, laminated iron core; *C*, annular air gap; *VC*, voltage coils connected in series or parallel; *CC*, current coils connected in series or parallel; *LC*, lag coil connected in series; *X*, non-inductive resistance for *LC*; *BC*, balance coils.

The current windings, *CC*, are wound and connected to binding posts in a manner identical to that shown in Fig. 3 for ammeter primary windings, *PC*. The voltage windings *VC* consist of two fine wire coils, one on each leg of the laminated iron structure and arranged for series-parallel connection by

bringing the terminals to suitable stationary studs and flexible connections. The meter can, by means of these connections, be quickly adapted for either 100-200 volts or 200-400 volts.

The moving element is identical in construction to that employed in the ammeter, differing only in the metal used, which is a special alloy having low temperature coefficient rather than aluminum, for the reason that not having the automatic temperature correction effect offered by the series transformer construction employed in the ammeter, a metal is necessary whose resistance is practically unaffected by temperature variations. The actual temperature coefficient is .07 per cent per degree Centigrade. In general appearance the single-phase wattmeter is similar to the ammeter and voltmeter.

From the illustration (Fig. 5) it will be seen that the principle involved is that of a miniature induction motor having for a rotor the pivoted drum and a bipolar field built up of thin laminated iron, the polar projections of which partially surround a mass of circular laminations, thus giving the annular gap, *C*, in which the rotor is pivoted.

The voltage windings, *VC*, consist of a large number of turns on the iron core, *A*, having high self-induction owing to which fact the current in this winding lags approximately 90 deg. behind the impressed e. m. f. of the source of supply or line voltage. The series or current windings, *CC-CC*, consist of a few turns of comparatively heavy wire wound on the pole pieces of the iron laminated structure *A*. This winding is of very low self-induction and is connected in series in the circuit the current in which is to be measured.

Neglecting for the moment iron loss and resistance loss in the shunt or voltage coil, *VC*, and therefore assuming the magnetism of this circuit to lag exactly 90 deg. behind the impressed e. m. f. or line voltage, it will be seen that with a non-inductive load consisting of incandescent lamps, the current in the series coil, *CC*, is in phase with the line voltage and the current in the shunt circuit *VC* is behind the voltage. Therefore, as the currents in the circuits *VC* and *CC* differ 90 deg. in phase, there are produced magnetic fields at right angles to each other and these fields passing through the pivoted rotor produce a rotary field which gives the rotor the required torque or turning moment. The movement of this pivoted rotor is opposed by the restraining force of a control spring, so that the point of equilibrium between the turning torque of the rotor and restraining action of the control spring will be indicated by the pointer and in conjunction with a properly calibrated scale gives a direct indication of the power in the circuit.

If, however, a meter involving only the windings *VC* and *CC* referred to above is employed, it will register correctly on non-inductive load only, reading incorrectly as the load becomes inductive and the power factor becomes less than unity. The reason for this difference in reading on non-inductive and inductive loads is that the phase angle between the circuit in coils *VC*

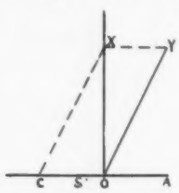


FIG. 6.—VECTOR DIAGRAM.

and *CC* is not exactly 90 deg., owing to the iron and copper losses in the shunt or voltage coils *VC*, and therefore the angle between the shunt and series magnetism acting on the rotor is somewhat less than 90 deg. A meter, therefore, will not read correctly on low-power factors unless this discrepancy in phase angle is compensated for in some manner. The necessary compensation is accomplished by the auxiliary lagging windings, *LC*, connected in series and short circuited on themselves through a short piece of German silver wire, *X*, forming a non-inductive circuit. This auxiliary lagging winding is so located that its field reacts on the field of the shunt or voltage coil *VC*, and by properly adjusting the resistance, *X*, the resultant magnetic field is exactly 90 deg. behind the impressed e. m. f. This method of securing the resultant field can be better understood by referring to Fig. 6, in which *OA* represents the voltage of shunt coil *VC*; *OY*, the current passing through *VC*, and *YOA*, the angle less than 90 deg. due to iron and copper losses in *VC-VC*.

OS represents the induced voltage of lagging winding *LC* approximately opposite in phase relation to that of *OA*, but very small in value—the current passing through resistance *X* being in phase and equal approximately to *OC*. This current, *OC*, and the main current, *OY*, have a combined magnetizing effect on the iron core, which effect is found by forming the parallelogram *OCXY*, when *OX* is the resultant effect now practically at right angles to the impressed e. m. f. of the circuit. By varying the amount of resistance *X*, the magnetism can thus be shifted back to the proper angle, so as to make the meter read correctly at all conditions of power factor for a given frequency.

The polyphase meter consists of two separate single-phase elements mounted in a single case and having a common shaft carrying the two rotors, which thus revolve in separate fields. This construction insures a meter which is correct on either two-phase or three-phase circuits under any condition of unbalancing, power factor, etc. One of these is shown in Fig. 7.

The meter indications are practically free from disturbing effects of stray or external magnetic fields generated by heavy currents or magnetic material in proximity to the meters, this freedom being secured by the electromagnetic construction which gives an intense concentrated field much stronger than any field to which the meters will ordinarily be subjected. The dead-beat qualities of the meter indications are due to the damping action resulting from movement of the metallic drum across the electromagnetic field produced by currents passing through the various windings, this movement giving rise to "Foucault" or eddy currents, the magnetic field of which, acting in opposition to the generating field, tends to damp and prevent oscillation of the closed conductor. Slight motion of the pointers sometimes observed during readings is due to actual variations in the power, which the pointer exactly follows.

The torque or turning moment is very high for indicating

FIG. 7.—PORTABLE INDUCTION TYPE POLYPHASE WATTMETER.

meters, thus permitting the use of heavy controlling springs which, in conjunction with the light weight and highly polished bearing surfaces, insures a construction which will quickly, accurately and positively respond to the slightest changes in load, current or pressure. The full scale torque of the various meters is approximately 20 millimeter grammes.

The scale of ammeters and voltmeters gives deflections proportional in degree to the square of the current or voltage and gives very open readings except at the lower end. The wattmeter scales are uniform from zero to full scale reading and are very satisfactory as to length and legibility. The length of the scales forms one of the most noticeable features of the meters, materially adding to their value in service.

When it is desired to measure currents in excess of the meter

capacity, the portable series "Plug Type" transformers (Fig. 8) are found useful. For instance, assuming it is desired to accurately measure currents varying from 1 to 100 amperes, an ammeter having series parallel windings of 5 and 10 amperes would be used in conjunction with a "Plug Type" series transformer having a 5-ampere secondary and primary of 25, 50 and 100 amperes. With this construction the useful range of the ammeter would be as follows: 1 to 5 amperes reading in .05

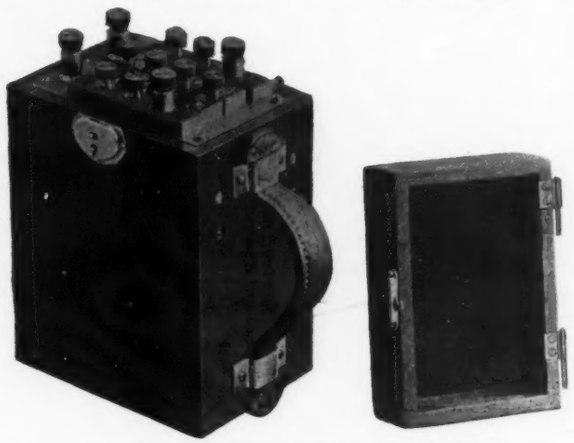


FIG. 8.—PLUG TYPE SERIES TRANSFORMER.

ampere divisions; 2 to 10 amperes reading in .1 ampere divisions; 5 to 25 amperes reading in .25 ampere divisions; 10 to 50 amperes reading in .5 ampere divisions; 20 to 100 amperes reading in 1. ampere divisions.

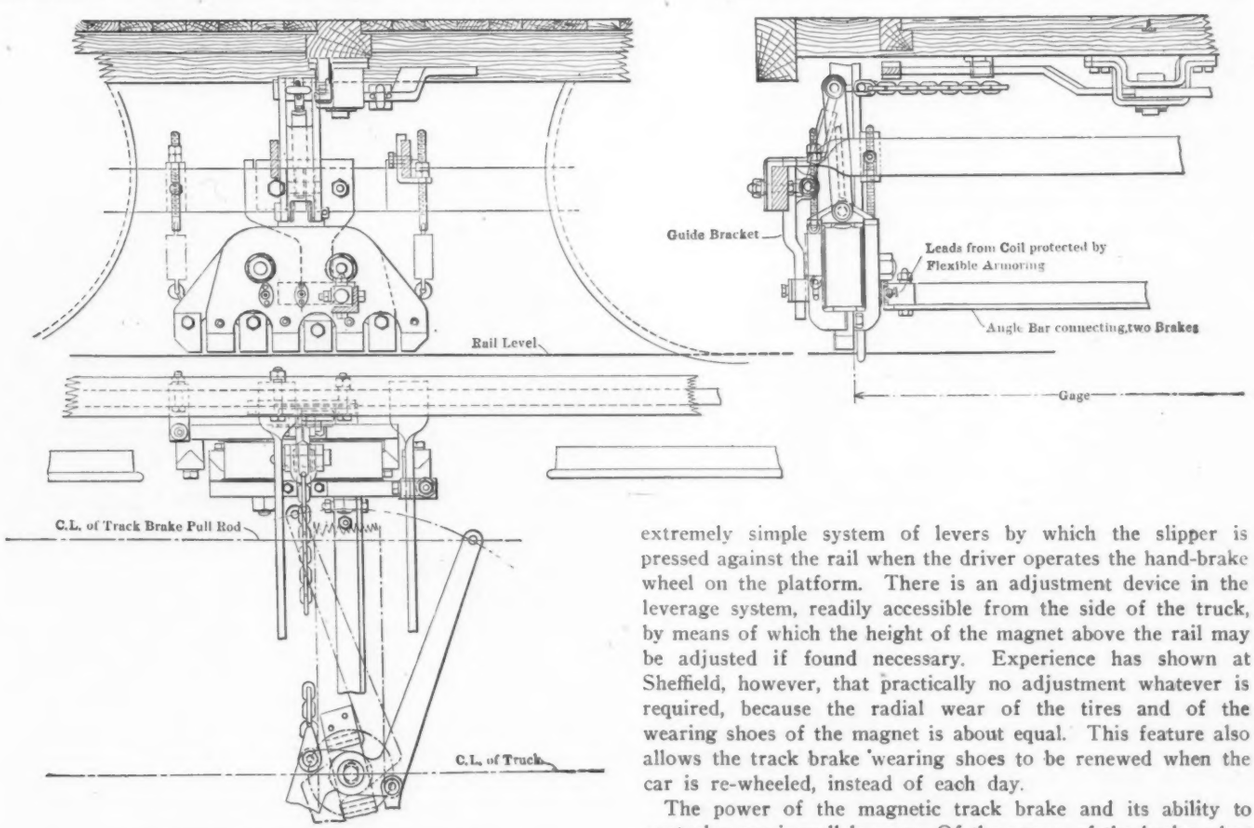
The transformer can also be profitably employed with the wattmeters, as for instance, assuming it is desired to measure single-phase loads varying from 50 to 10,000 watts at 100 volts a wattmeter having series parallel winding of 5 and 10 amperes would be used in conjunction with the series transformer recommended for use with the ammeter and the following full scale capacities could be secured in the wattmeter: 0-500 watts reading in 2 watt divisions; 0-1000 watts reading in 4 watt divisions; 0-2500 watts reading in 10 watt divisions; 0-5000 watts reading in 20 watt divisions; 0-10,000 watts reading in 40 watt divisions. The meter also being provided with 200 volt potential winding could be used to measure loads double the capacities given above.

With the ordinary single-scale meters it would (in order to secure sufficient scale deflection at each load) be necessary to employ at least one each of the following capacities: 5, 10, 25, 100 amperes. In this way a sufficiently large deflection could be obtained on each meter to enable them to be used at their most accurate capacity. The combination suggested, however, accomplishes with one meter and one transformer the same results as would be secured by the use of four ordinary meters. The same combinations are also applicable to polyphase measurements by employing two series transformers with a 5-10 ampere polyphase meter.

The advantages of the "induction type" meters are briefly as follows: Absence of moving wire or iron, light and simple moving elements, long open scales, freedom from stray field effect, inherently dead-beat.

Development of Track Brakes.

An improved form of track brake has been supplied to the Sheffield Corporation by the British Thomson-Houston Company which is a combined magnetic and mechanical track brake, so designed that it can be applied by the driver either as an ordinary mechanical slipper brake, or as an electro-magnetic track brake, or as both combined. The general features of the brake will be apparent from the accompanying drawing. The track slipper consists of the usual form of "B. T. H." track brake magnet, one attached to each side of the truck, with an extremely simple system of levers by which the slipper is pressed against the rail when the driver operates the hand-brake wheel on the platform. There is an adjustment device in the leverage system, readily accessible from the side of the truck, by means of which the height of the magnet above the rail may be adjusted if found necessary. Experience has shown at Sheffield, however, that practically no adjustment whatever is required, because the radial wear of the tires and of the wearing shoes of the magnet is about equal. This feature also allows the track brake wearing shoes to be renewed when the car is re-wheeled, instead of each day.



DIAGRAMMATIC VIEW OF TRACK BRAKE.

The power of the magnetic track brake and its ability to control a car is well known. Of the power of the brake when applied mechanically, the following test, carried out at Sheffield, gives ample testimony. The car was driven at full speed on a level track with the motors in full parallel. The track brake was then applied mechanically by hand without shutting off power. This rapidly brought the car to rest, the wheels spinning on the track through being driven by the motors. The

ability of the brake to stop the car when the full power of the motors is acting to keep the car in motion, is ample proof of its great power and efficacy. When it is also remembered that the action of the brake is in no way dependent upon the rotation of the wheels, and that the brake cannot in any case lock the wheels it will be appreciated that it is thoroughly reliable.

Porcelain Insulators for High-Tension Circuits.

The porcelain insulators shown in section herewith have been designed by the Karlsbader Kaolin Industrie Gesellschaft, of Merkelsgrün bei Karlsbad, in Bohemia, to combine all the theoretical and practical experience thus far gained by those engaged on high-tension work. The characteristics necessary in insulators for proper protection are attained according to the various kinds of porcelain employed. On this latter point a few words on porcelain for insulation purposes may not be out of place.

Porcelain consists of a mixture of kaolin (a material made plastic in the damp state by the clay and silicic acid contained in it), quartz (silicic acid) and felspar (a dissolvable mineral consisting of clay, silicic acid and potash). The glazing is composed of the same materials with the exception that it contains a larger quantity of felspar and an addition of lime or some substance containing magnesia, in order that it may flow easily when fired. The porcelain material consists of silicates and double silicates of clay, potash and lime together with silicic acid, only mechanically combined, in which when subjected to heat, the melting molecules cement together with those not melting, but only softening.

For high tension insulators the combination of materials employed so far does not suffice; but the mass must be closely united so that its surface as an insulator may be effective. Experiments have proved that not only the flux, but also the materials richest in silicic acid possess the greatest power of insulation. On the plasticity of the kaolin depends the quantity of flux and silicic acid absorbed, and only pure Zettlitz kaolin from the company's own mines is used. While the mass must contain a certain amount of clay to give it the necessary firmness when subjected to heat, the glazing must at the same temperature become quite liquid and spread over the surface of the mass.

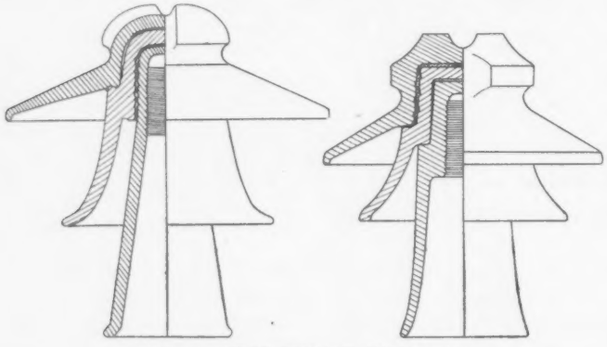


FIG. 1.—HIGH-TENSION INSULATOR.

Insulation against loss of current in consequence of its leakage on the surface during rain or fog has been considered just as much in the construction of the insulators as insulation against puncture. The causes which bring about losses are too well known to need further mention here. The separate mantles or petticoats are so arranged that no insects or dirt can collect between them and the slope and form are such that even in heavy rains, water cannot collect. The various insulators are so constructed that with a higher tension larger upper surface insulation has been taken into consideration. An endeavor was made in the construction of the high-tension insulators to guard against the formation of sparks during rainfall. The insulators are made with petticoats which easily shed the water, and as a further protection a special porcelain carrier encircling the iron bolt rests on the support in such manner that the stretching of the wire will not affect it. These supports prevent discharges from the surface of the insulator to the bolt. The insulators are designed for cables of 50 mm. diameter and a maximum span of 75 yards. These measurements are the result of dynamic experiments, changes of temperature and the weather being taken into consideration. In the case of insulators for tensions under 15,000 volts, a thinner wall would have sufficed; but in order to insure mechanical stability, the thicker wall is preferred. The insulators shown will stand tensions of from 6000 to 60,000 volts. Each insulator is tested before shipment, the company having facilities for varying the voltage from 500 to 120,000 volts. A 180-kw, three-phase alternator is used to supply the testing transformer, and the insulators filled with water are subjected to the high tension current for two hours.

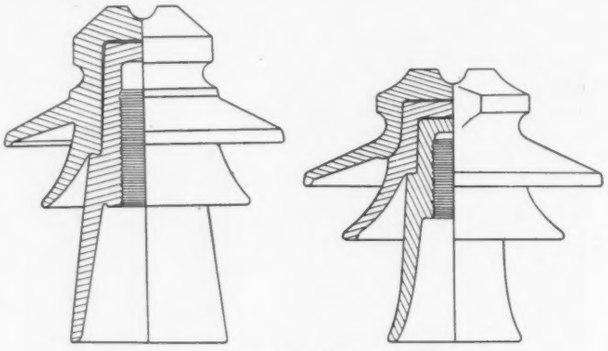


FIG. 2.—HIGH-TENSION INSULATOR.

Insulating Varnishes.

There has recently been placed in the market a new insulating varnish known as "Benolite" which is claimed to possess high dielectric strength and great flexibility, and yet contains no linseed oil and no metallic driers, nor is it an alcohol or spirit varnish and does not depend upon China wood oil (Tung oil) for its characteristics. Many of the present insulating varnishes depend on linseed oil for their principal characteristics. Linseed oil dries by oxidation, the oxygen being furnished by metallic driers mixed with the oil. There would be no objection to this, providing the metallic driers were well selected, if the oxidation could be stopped at the desired point. This, however, is impossible, it is said, and in any linseed oil varnish oxidation continues until flexibility is destroyed and the insulating properties considerably lessened.

Benolite is a black, water-proof, oil-proof, flexible varnish which can be air dried in four to six hours and can be baked at 212 deg. F. in one to two hours. It consists of a combination of materials which dry by chemical action but not by oxidation. This action is such that no metallic driers are necessary and the action stops altogether at a point where the varnish retains a permanent flexibility. The gums which form a considerable part of the varnish are such as to make it entirely water-proof, but for the first few days these gums may be affected by oil. After this time, however, the chemical change which takes place renders them absolutely oil-proof. Benolite is stated to have considerable power of penetration into cloth, one remarkable fact being that the entire varnish and not simply the volatile solvent penetrates the cloth. Once dry, Benolite is absolutely acid and alkali proof, the varnish not only being unaffected itself but absolutely protecting the copper or cloth beneath from corrosive action.

A single layer of cotton tape painted with Benolite, the total thickness being about .025 in., is stated to have a dielectric strength of from six to ten thousand volts. A superior in-

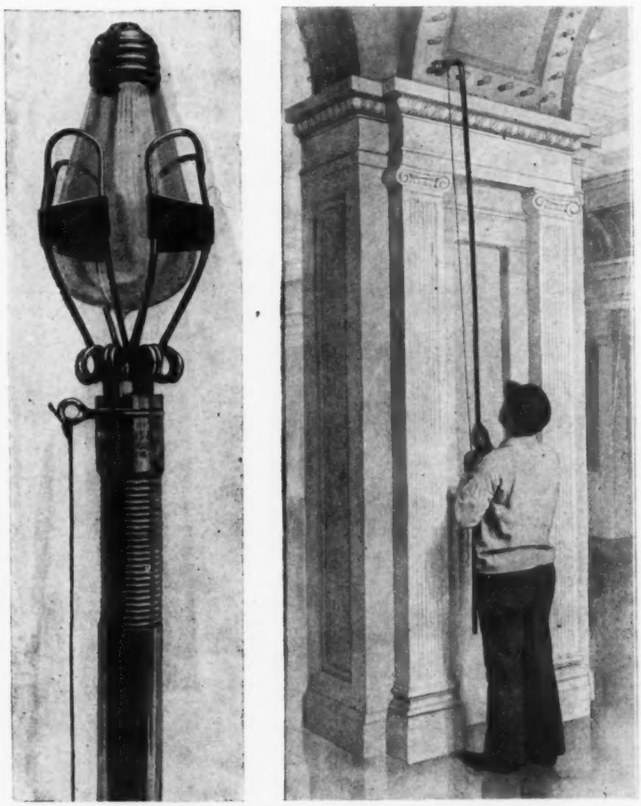
sulation can be obtained by taping the article with cotton or linen tape, painting four or five times with Benolite, drying each coat about two hours, then applying a second layer of tape and painting with Benolite as before, repeating the taping and painting as many times as is desired. The Benolite thoroughly penetrates the tape and forms a fine, glossy surface over each layer. The result is a thoroughly homogeneous mass of insulation having a high dielectric strength.

Benolite can also be used to advantage as a compound for field coils. The fact that it dries by chemical action makes it unnecessary to be in contact with the air to dry, and its penetrating qualities and flexibility make it an excellent material for this kind of work. In the repair shops, where facilities are not always at hand for baking, Benolite shows up to advantage. Field coils can be dipped in the varnish and set aside to dry, the result being fully as satisfactory, it is asserted, as coils impregnated by means of expensive vacuum apparatus. Armature coils can be built up with Benolite, and within a few hours a result obtained which would require as many days with a baking varnish. After the machine is assembled, the whole can be painted with Benolite and the result will be a machine of high dielectric strength, which is proof against water, oil, acids and alkalies.

The new material is made by the Benolite Company, of Pittsburg.

Changing Lamps in the Socket.

Some kind of special device is always necessary for reaching incandescent lamps on high ceilings, lofty chandeliers, etc., and herewith is illustrated in Figs. 1 and 2 the "Easy Lamp Changer," which W. N. Matthews & Bro., of St. Louis, took



FIGS. 1 AND 2.—LAMP CHANGER.

over recently from the Partridge Shade & Reflector Company, of Chicago, and are now putting on the market themselves. Fig. 1 shows the appliance in detail, holding a lamp which has just been removed from its socket. Fig. 2 shows the ease with which decorative lamps out of ordinary arm's reach can be dealt with by the device.

The "Easy Lamp Changer" is built on the same principle as the human hand. It has a set of artificial fingers which close over and grasp the lamp firmly while it is being removed or replaced in the socket. The rubber bands over the ends of the fingers prevent the lamp from slipping while it is being turned in. The double coil spring permits the shaft or wrist to this hand-like device to be bent at any angle. This is accomplished by holding the pole firmly in one hand and pulling down on the string with the other. By turning the pole to the right the lamp may be inserted, or it may be taken out by turning it to the left.

The changer fits all lamps from 6 cp up to and including 32 cp. Anybody with ordinary dexterity can use the device with success without previous experience.

Equipment in a Paper Mill.

The Willamette Pulp & Paper Company, of Oregon City, Ore., has just added to its plant a second factory which, with the older mill enables the company to produce 140 tons of paper per day. The complete plant of the Willamette Pulp & Paper Company is one of the largest of the kind on the Pacific Coast and supplies paper for the principal daily newspapers of the Northwest. The new mill, being for the most part electrically driven, furnishes an excellent example of the advantages of this flexible method of power distribution. The Willamette River at this place has a fall of about 25 feet and the old mill of the company is located at the brink of the falls. The new mill is about 1000 feet distant and is driven by induction motors supplied with current from a water wheel driven generator located in the old mill. By utilizing the electric system in this way, it has been possible to develop some 750 additional horsepower at the falls and at the same time locate the mill advantageously.

The electrical equipment was furnished by the General Electric Company, and consists of a 600-kw, three-phase, 600-volt revolving field, alternating-current generator direct connected to a 1000-hp water wheel built by the Platt Iron Works. The power is transmitted directly at the generator voltage. To insure against a shutdown in the new mill, arrangements have been made with the local company for power, should any accident happen to the paper company's generating equipment.

In the new mill, both group and individual induction motor drives have been arranged. The motors are all of the squirrel-cage type and operate at 550 volts. One group consists of a 12-in. x 13-in. chipper, a chip separator, a saw dust conveyor and a bucket-hoist, driven by a 200-hp induction motor. The motor is operated about eight hours per day and carries load easily no matter how hard the chipper is crowded. The bucket-hoist carries the chips into bins ready for the digester. A second group, driven by a 200-hp induction motor consists of three pumps and four beaters, each handling 650 lbs. of pulp. This motor runs continuously 24 hours per day. The beater load fluctuates greatly, varying with the amount of moisture in the pulp and the amount of pressure exerted by the operation. Owing to the large starting effort required for the beaters, a friction clutch is inserted in the line shaft so that the motor can come up to speed without load and then take the load gradually by means of the clutch.

A third induction motor having a capacity of 100 hp drives two chest-agitators and three pumps. The paper is reduced to the proper consistency for the paper machines in a Jordan engine which is driven by a 100-hp motor. A 10-hp motor is belted to the elevator. This motor runs continuously, taking full load only when the elevator is in use. The four wet machines and three Decker machines are also driven from a counter-shaft belted to a 50-hp induction motor.

Steam power is used for the operation of the 152-in. Fourdrinier paper-making machine. A 650-hp noncondensing engine is used for this purpose, the exhaust steam being piped to the drying cylinders on which the paper is rolled before being calendered and reeled.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—With continued favorable weather, improved conditions are reported in retail and jobbing lines, the crop outlook and in mercantile collections. Jobbers and wholesalers are receiving liberal orders for fall and winter merchandise, and interior buyers are active in the primary markets. Crop reports are more encouraging than the latest official statement, indicating much improvement since July 1, on account of favorable weather. Manufacturing returns tell of large orders on hand and very heavy production during the first half of the year. Freight tonnage is well maintained, gross railway earnings in the first week of July exceeding last year's by 12.1 per cent. The latest figures available show that railway gross earnings in June exceeded those of the same month last year by 13.4 per cent, the mileage represented aggregating 93,500. For the full fiscal year ending with June the increase over the corresponding period for 1905-06 is 9.6 per cent. Returns for May indicate large gains in net earnings, the increase as compared with May, 1906, being something over 13 per cent. Foreign commerce at the port of New York for the last week shows gains of $4,253,375 in imports and $269,555 in exports, as compared with the corresponding week of 1906. Great activity is noted in the leading industries. The demand for iron is quiet, but production is at the maximum, and the six months' production breaks all records. The demand for structural material is light, but it is stated that some heavy business is pending. Lake ship builders are specifying heavily on materials for vessels. Copper is much lower, the long-expected "official" break in prices having materialized. Some new business followed as the result of the reduced prices, but thus far there was no general buying movement, and there was a disposition to question whether prices have been lowered sufficiently to induce an active demand from American concerns. The closing quotations are 22c. for Lake; 21⅝c. for electrolytic and 20¾c. for casting stock. The commercial failures in the United States during the first half of 1907, were 5607 in number and $69,568,662 in amount of defaulted indebtedness. This is the best statement as to number of bankruptcies for the corresponding six months of any year since 1899, but liabilities were slightly above the average on account of a few very large failures in New York. In the first half of 1906 there were 5612 failures, involving $62,664,074. The number of failures during the past week as reported by *Bradstreet's* was 185 against 135 in the week previous and 143 in the corresponding week last year.

THE ENGINEER COMPANY, Trinity Building, New York City, has just issued the following announcement: "We beg to advise of a change in policy and personnel of the Engineer Company. Mr. Henry B. Haigh and Mr. John MacCormack have resigned as president and second vice-president, respectively, and their interests in the Engineer Company have been absorbed by Mr. Embury McLean as president. Mr. MacCormack will engage independently in the manufacture of his stoker, the Engineer Company having relinquished to him its rights in his patents. This relieves the Engineer Company of the commercial development of a stoker and leaves a free field for the installation of 'balanced draft' in connection with any boiler furnaces, whether hand-fired or operated with any of the various mechanical stokers. At the present writing upwards of half a million horse-power of boilers are being operated with 'balanced draft' under license from the Engineer Company. Tables showing fuel economy and capacity increases resulting from the use of this system will be gladly furnished upon request. The present officers of the Engineer Company are: Messrs. Embury McLean, president; John C. Quinn, vice-president; North McLean, treasurer; R. E. Fox, secretary and manager of sales department, and the new board of directors includes, besides the above, Messrs. J. F. Tapley, R. M. Searle and George Davies."

ELECTRIC VEHICLE COMPANY.—It is announced, as already foreshadowed in these pages, that a number of important changes in the Electric Vehicle Company, of Hartford, Conn., will take place. Harry W. Kyte, who has been secretary and assistant treasurer, was elected third vice-president and made manager of the sales department. H. W. Nuckols, who has been assistant to Mr. Kyte, was elected secretary and assistant treasurer. These appointments were made at a special meeting of the directors. Hiram Percy Maxim, chief engineer of the company, is to resign on Aug. 1, as already stated in this column. He is to form a company in Hartford to manufacture automobiles. Mr. Kyte has been five years in Hartford and for five years previous he was in Chicago with the Electric Vehicle Company and its subsidiary companies. Heretofore, President M. J. Budlong and other officials have had an oversight of the sales department. The office of third vice-president was created for Mr. Kyte and he will give much of his time to the salesmen. When Mr. Maxim leaves the employ of the company on Aug. 1 he will open an office and start operations on a new automobile company, which is to be formed of Hartford and New York men. The company will build electric pleasure cars and commercial vehicles at first, and later will build gasoline cars. As soon as possible it will put up its own buildings.

ELECTRIC PROPELLER FANS.—Summer weather marks a great increase in sales of electric propeller fans by the B. F. Sturtevant Company, of Boston, Mass., who, among others, report the following: The Hollenden Hotel Company, Cleveland, Ohio; Electric Supply Company, Charleston, S. C.; Seymour Packing Company, Topeka, Kan.; American Laundry Company, Grand Rapids, Mich.; E. Greenfield's Son & Company, Brooklyn, N. Y.; C. C. Richardson Paper Company, Lockland, Ohio; John K. How Company, Baltimore, Md.; Winchell School, Boston, Mass.; R. T. Ford, Rochester, N. Y.; Patchogue Manufacturing Company, Patchogue, L. I., N. Y.; the Pueblo & Suburban Traction & Light Company, Pueblo, Col.; Armour Packing Company, Kansas City, Mo.; Chronophone Company, Collinwood, Ohio; New York Telephone Company, New York City; Alton Paving, Building & Fire Brick Company, Alton, Ill., and Waterbury Farrel Foundry & Machine Company, Waterbury, Conn.

STEEL CONCRETE CHIMNEYS.—At Worcester, Mass., a new steel-concrete stack, the largest of its kind in this country, has been completed at the north works of the American Steel & Wire Company and put into use. The new stack is 220 feet in height and has an inside diameter of 9 feet and outside diameter at the base of 12 feet 6 inches. The structure is of concrete reinforced with steel and was erected by the Weber Steel-Concrete Chimney Company of Chicago. The stack will carry a battery of 12 boilers used in connection with an economizer. It is said that the stack is the largest of steel-concrete structures in this country and only one in the world is larger, and this is located in England. Steel-concrete chimneys have been popular in England many years, but only recently have been introduced into American manufacturing plants.

WESTINGHOUSE SHIPMENTS.—During the month of May the Westinghouse Electric Works at East Pittsburg shipped 750 carloads of electrical machinery, or an average of 30 carloads a day, aggregating 10,000 tons and representing in value about $4,000,000. This exceeds by 110 cars any shipping record for one month that has ever been made at these works. The high record heretofore was held by the month of August, 1906, when 640 carloads were shipped. The shipments at the Westinghouse Machine Company's shops during May also reached the high-water mark, the company having sent out from the works 90 engines, aggregating 50,000 horse-power. These engines included gas engines from 10 to 1000 horse-power and steam turbines from 1000 to 10,000 horse-power.

COOL AIR FOR JAPAN.—Just now when we are treating our excellent Japanese friends to so much "hot air," it deserves note that recent exports to Yokohama have included a large shipment of electric propeller fans.

E. H. FREEMAN ELECTRIC COMPANY.—The Trenton *Times* has the following item: Compelled by rapidly increasing business to extend its manufacturing facilities, the E. H. Freeman Electric Company of this city is making arrangements to add a third plant to the two already operated by the company. The concern manufactures all kinds of fittings for electric wiring and lighting. It conducts a pottery at Prince and Meade Streets, East Trenton, where the porcelain parts are turned out. The brass and copper work is done in a factory at Hamilton Avenue and the Delaware and Raritan Canal. The assembling is done at the latter place. The Freeman Company turns out the fittings complete, with porcelain and metal work combined ready for installation. The company has secured the large brick building on Chambers Street, near State Street, formerly occupied by George W. Price as a pork packing establishment. This will be renovated, refitted and made into an up-to-date assembling plant. The new building will be ready for business July 1. With the assembling department removed from the Hamilton Avenue plant additional room that is badly needed there for manufacturing purposes will be obtained. After the assembling department is removed from the metal factory that plant will be extensively improved. The interior will be remodeled and additional machinery installed, largely increasing the manufacturing capacity. By improvements at the pottery, also, that plant will be almost doubled in capacity. The present kiln shed will be torn out and a new kiln erected. This will give additional space in which several new presses will be installed, thus greatly increasing the porcelain output. The new Chambers Street plant will have 7000 sq. ft. of floor space, and altogether the three plants will give the company more than 25,000 sq. ft. of manufacturing floor space. Though the company has been organized only since April, 1904, it has built up a large trade. When the changes here outlined are completed about 200 hands will be employed in the three plants. E. H. Freeman is president of the company and Lambert Alpaugh is treasurer. The company has also just commenced the manufacture of a new socket. The company has just put this on the market, but has already received orders for 100,000 sockets. The Freeman Company furnished all the fittings for the Jamestown Exposition and has just shipped an order of 25,000 fuse plugs to Spokane, Wash. Goods are being exported to Manila, South America and other foreign countries.

LARGE SIGNAL ORDER.—The General Railway Signal Company, Rochester, N. Y., has received the contract for all the signal and interlocking appliances to be installed in the tunnels of the Hudson Companies. The first section to be signaled consists of the double-track line about 2½ miles from the terminal station at Henderson Street, in Hoboken, N. J., through the completed tunnels under the Hudson River to the foot of Morton Street, New York, and through to the station at Christopher and Greenwich Streets, a total of about 5¼ miles of track. The contract calls for the complete installation on this section of the signal apparatus, ready for operation, by Sept. 1. The contract also includes the signal apparatus in the river tunnels and terminal station at Cortlandt Street, and in the extension of the Morton Street tunnels north under Sixth Avenue to the terminal station at Thirty-Fourth Street. These parts of the system will not be completed for some time. The road is to be operated with direct current, using the third rail, and trains of two or more cars will be run. The alternating-current track-circuit apparatus of the General Railway Signal Company, which has been installed in the electric zone of the New York Central will be employed, with some slight modifications. The automatic block signals are to be arranged with double overlap and the Kinsman automatic stop. The latest form of Kinsman contact rail and shoe apparatus will be employed, the contact rail for the automatic stop being placed outside of the track rails and between them and the third rail.

COPPER IN EUROPE.—A recent cable dispatch from Paris on the copper situation in Europe, quotes as follows the secretary of the Compagnie Electro Metallurgique, a large concern using quantities of copper: "The decline is too small to make any difference to us. We are virtually dependent on America for our copper supply, and the price is still so high that we are compelled to restrict purchases. We could go ahead if the metal were obtainable for £80 a ton, but £98 is an almost prohibitive figure. Unfortunately, I see small prospect of any substantial reduction. I look upon the recent decline as a merely speculative movement, unlikely to have an important bearing on industrial affairs. Undoubtedly mines which formerly could not be worked profitably are contributing to make the world's supply larger, but the effect has hitherto been small. As consumers we can only hope that the addition of numerous small sources will follow the principle of little streams making big rivers and bring copper to a reasonable figure. Japan is making progress as a producer. I am constantly receiving offers of lots of 400 or 500 tons of Japanese copper, which, though unsuitable for some purposes owing to its large proportion of silver, competes to some extent with American copper."

APPARATUS FOR CANADA.—The Board of Control, Winnipeg, Manitoba, Canada, desires tenders for the whole works, groups, or individual contracts, for the following: (3) telephone system; (4) general works at Point du Bois; (5) 4000-hp turbines (five); (6) 450-hp turbines (two); (7) 3000-kw generators (five); (8) 250-kw generators (two); (9) induction motors (one); (10) step-up transformers (five); (11) generating station, switching and accessory apparatus; (12) generating station, light, heat and power systems; (13) generating station, oil and air systems; (14) erection of transmission system (75 miles); (15) steel towers; (16) high-tension insulators; (17) electric transmission cable; (18) terminal station; (19) step-down transformers (five); (20) terminal station, switching and accessory apparatus; (21) terminal station, light, heat and power systems; (22) terminal station, oil and air systems; (24) testing transformers and apparatus; (25) electric traveling cranes (three); (26) turbine governors (seven); (27) auxiliary apparatus; (28) repair shops. Specifications can be obtained from the power engineer, Carnegie Library Buildings, Winnipeg.

ADDITIONS TO WESTINGHOUSE WORKS.—Most of the Westinghouse companies are now making considerable additions to their works, among which is a new eight-story steel structure for the Electric Company, which will be ready for occupancy by Aug. 1. This will give an addition of 250,000 sq. ft. of floor space, to be utilized for the construction of details and supplies. The Air Brake Company, in Wilmerding, has now in course of erection a core shop 85 ft. x 140 ft., a pattern shop and pattern storeroom 80 ft. x 330 ft., and is about to begin the erection of a new carpenter shop 45 ft. x 120 ft. The Union Switch & Signal Company has several hundred men at work on the site recently acquired for the erection of additional shops.

NERNST LAMP ORDERS.—The Nernst Lamp Company reports that within the last week it has received contracts which represent a larger number of candle-power than any individual lighting contract made since electric lamps became the popular form of artificial lighting. One of these contracts, from the Baltimore Electric Company, calls for lamps aggregating 1,300,000 candle-power, and another from Marshall Field & Company, of Chicago, for lighting their dry goods store, calls for 700,000 candle-power, making a total of 2,000,000 candle-power. Another contract which the company is now turning out in its shops is 1,000,000 candle-power for the new terminal station of the Pennsylvania Railroad in New York City.

THE ELECTRIC CABLE COMPANY, of New York, has just bought the entire business of the Eastern Wire & Cable Company, of Roxbury, Mass. The latter company is one of the oldest and largest manufacturers of rubber-covered wires and cables in New England. Its entire equipment will be removed to Bridgeport, Conn., where is will be installed in the plant of the Electric Cable Company, which has in course of construction a large addition to its plant. The officers of the Electric Cable Company are: President, Edwin W. Moore; vice-president, F. H. Cowles; treasurer, J. Nelson Shreve.

SOUTH AMERICAN SUBWAY.—A South American firm writes to the U. S. Bureau of Manufactures, Washington, that the country in which it is located is likely, within the next two years, to commence to build a tunnel system to handle the increased traffic. The system will embrace 70 miles of tunnel and the firm desires to be placed in communication with American engineers who are interested in the project.

REINFORCED CONCRETE POLES.—Nearly a year ago, experiments were begun at Richmond, Ind., with a view to discover a substitute for wooden telephone and telegraph poles. Mr. William Bailey, superintendent of the Richmond Home Telephone Company, made a series of tests with reinforced concrete, with the result that he has produced a pole 30 ft. in height, octagonal in shape, tapering toward the top, with

mortises to be used in climbing and for the insertion of cross-arms. A number of these poles were erected on one of the main lines of the company, and a short line in the bottom was constructed wholly of concrete poles. After a year in service, it has been found that the poles have given as much satisfaction as the wooden ones, and have the additional virtue of being almost indestructible. Mr. Bailey has been the recipient of scores of letters of inquiry by pole-line companies all over the country as a result of publicity given to his experiments. The pole itself could not be patented, but the manner of construction has been patented. On July 8, the American Concrete Pole Company was organized at Richmond with James A. Brailey, of Toledo, Ohio, as president. Associated with Mr. Brailey are Messrs. William Bailey, the inventor; W. P. Orr, S. K. Statler and L. M. Flesh, of Piqua, Ohio; A. C. Lindemuth, Jno. M. Lotz, E. H. Cates and L. E. Brown, of Richmond. The company will incorporate at once, and proposes to establish a number of plants throughout the country.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market closed with firmer prices and moderate activity after having shown sharp declines, in the midweek, as a result of higher money, the reduction in copper values, governmental attacks on corporations, and other adverse developments. The practical failure of the Atchison and Union Pacific bond subscriptions was also regarded as unsettling. Union Pacific took the lead in the decline which began on Tuesday, and became quite severe in Wednesday's transactions. At the same time, a comparatively few stocks, like Amalgamated, Union Pacific, St. Paul and other active speculative features, supplied the bulk of the dealings, the declines in other directions being of a sympathetic nature. Thursday's market showed more or less indecision. In spite of the fact that money inclined to harden, the renewal rate for call loans rising to 6½ per cent, the market halted and scattered covering created a slightly better range of prices in many cases, this movement assuming a more decided form on Friday. The week closed with an active market, with broad buying and general gains throughout the list. More favorable financial and speculative prospects abroad, together with the increased short interest, seemed to be responsible for this improvement. The electric stocks, however, did not feel the stimulus of the closing activity of other shares and the last quotations of the week were all lower, the heaviest decline being in General Electric—2¾ points net. The curb market was attended with quite heavy liquidation during the early part of the week, in sympathy with the declines on the stock exchange, but the market as a whole rallied later on though without any material increase in public interest. Following are the closing quotations of July 16:

NEW YORK.

	July 9	July 16		July 9	July 16
Allis-Chalmers Co.....	11¼	10	General Electric	137¾	135¼
Allis-Chalmers Co. pfd.	28¼	28	Hudson River Tel.....	—	—
Am. Dist. Tel.....	20	20	Interborough Met. com.	17	16¼
American Locomotive..	58½	58¾	Interborough Met. pfd..	45⅜	45
Amer. Locomotive pfd..	103	104	Mackay Cos.....	66⅝	67
American Tel. & Cable.	75	75	Mackay Cos pfd.....	65	65⅜
American Tel. & Tel...	108	106	Marconi Tel.	—	—
Brooklyn Rapid Transit.	59¼	58	Metropolitan St. Ry....	—	—
Electric Boat	33	33	N. Y. & N. J. Tel....	100	—
Electric Boat pfd.....	80	80	Western Union Tel....	77½	77½
Electric Vehicle	—	—	Westinghouse com.....	143	144½
Electric Vehicle pfd...	—	—	Westinghouse pfd.....	142	153

BOSTON.

	July 9	July 16		July 9	July 16
American Tel. & Tel..	109	107½	Mass. Elec. Ry. pfd....	*58	—
Cumberland Telephone..	—	—	Mexican Telephone.....	2¼	—
Edison Elec. Illum.....	215	210	New England Telp.....	110	111
General Electric	—	—	Western Tel. & Tel.....	5	—
Mass. Elec. Ry.....	16¼	17	West. Tel. & Tel. pfd..	*70	70

PHILADELPHIA.

	July 9	July 16		July 9	July 16
American Railways.....	48½	48½	Phila. Electric	8⅜	8⅜
Elec. Co. of America...	9⅞	9¼	Phila. Rapid Transit...	23½	23¼
Elec. Storage Battery...	52	51	Phila. Traction	93½	—
Elec. Stor. Battery pfd..	—	—			

CHICAGO.

	July 9	July 16		July 9	July 16
Chicago City Ry.....	160	—	National Carbon	71	—
Chicago Edison	*145	—	National Carbon pfd...	111	—
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.....	122½	—	Union Traction pfd....	—	—
Metropolitan Elec. com.	23	—			

*Asked.

LONG LEASE IN JERSEY.—Notwithstanding the opposition of the holders of one-half of 1 per cent of the stock of the United Electric Company of New Jersey, that concern was leased to the Public Service Corporation for a period of 999 years in Newark last week. The resolution favoring the lease was passed by the board of directors two weeks ago, at which time the directors of the Public Service Corporation accepted the proposition. The resolution provided that the lease be ratified by the stockholders of the United Electric Company, and the meeting was held in Newark last week. It was expected that of the 4000 shares of stock outstanding and not held by friends of the Public Service Corporation a big majority would co-operate with the known interests antagonistic to the plan, but when President Thomas N. McCarter showed how useful the Public Service Corporation had been to the United Electric, making possible the payment of dividends, more than half of the 1650 shares held by the opposition decided to vote for the lease. The opponents of the plan were represented by counsel, Judge Thomas L. Raymond, representing James M. Seymour, Jr., Leo Stern, several small holders, and Louis Hood, other holders, aggregating 300 to 400 shares. Further opposition is promised.

WESTINGHOUSE ACTIVITY.—Secretary Terry, of the Westinghouse Electric & Manufacturing Company, when asked if he had any comment to make concerning an article in New York *Sun*, replied that legal requirements make necessary a formal offering to stockholders of the company of any new shares to be issued, and, as is usual in such offerings, the directors of the company had authorized its treasurer to sell from time to time, at the price offered to shareholders of $75 per $50 share, any of the shares not subscribed for under the offering recently made. It is not the intention of the company to make a formal extension to the shareholders, because such an extension is not necessary. The officials of the company, considering the general conditions prevailing, regard subscriptions for 33,000 shares out of 100,000 as satisfactory, and the proceeds, coupled with other resources of the company, are sufficient to meet the needs of the company, which is making the largest sales in its history on a cash basis, with a manufacturing profit approximately 20 per cent on its shipments. Mr. Terry added that, with the sale of 33,000 shares, the company will also when needed have available $5,000,000 of its convertible sinking fund bonds to meet the requirements of a greatly enlarged business.

DIVIDENDS.—Directors of the Milwaukee Electric Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable July 31. Directors of the International Steam Pump Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Aug. 1. The directors of the Boston Edison Electric Illuminating Company have declared an extra dividend of 1 per cent, and it is said that they will distribute 12 per cent per annum hereafter. All the Westinghouse Companies have declared the usual quarterly dividend, the Air Brake Company 2⅛ per cent regular and 2⅛ per cent extra, the Switch & Signal Company 3 per cent on the preferred and 3 per cent on the common stock, the Machine Company 2⅛ per cent, and the Electric Company 2⅛ per cent. The directors of the Central District & Printing Telegraph Company, of Pittsburg (Bell Telephone), have declared the regular quarterly dividend of 2 per cent, payable July 31. The Grand Rapids, Mich., Railway Company has declared the regular quarterly dividend of 1¼ per cent.

STROWGER TELEPHONE BONDS.—The Strowger Automatic Telephone Exchange, the company owning the Strowger patents, is receiving subscriptions in Chicago for $50,000 7 per cent five-year bonds. These bonds are being issued for the purpose of providing funds for the general development of the company. One of the large items is the litigation which the company is carrying on with the company holding the manufacturing rights of the Strowger patents in this country. President J. L. Kesner said that the entire issue of $50,000 of bonds would be issued at once. As these bonds come ahead of the stock the issue of the bonds tends to weaken the stock.

CONNECTICUT STOCKS.—Application has been made to the New York Stock Exchange to list $8,142,900 preferred stock, $8,977,200 common stock, and $1,578,000 first and refunding mortgage 4½ per cent bonds of 1951 of the Connecticut Railway & Lighting Company.

WESTINGHOUSE NOTES.—Kuhn, Loeb & Company announce that all of the $6,000,000 Westinghouse Electric & Manufacturing Company 3 year, 6-per cent, collateral notes purchased by them recently have been sold.

GENERAL NEWS

Construction News.

PHOENIX, ARIZ.—The Harona Hola Development Company, recently incorporated, has chosen Captain F. S. Ingalls president; S. S. Green, vice-president, and C. T. Bonney, treasurer. The capital stock is $25,000. At Point of Rocks the company will build a submerged dam 500 feet wide and put in steel tubing and three miles of concrete tubing. The water power will be developed.

EUREKA SPRINGS, ARK.—M. D. Jordan, general manager of the Citizens' Electric Company, has made application for a receiver. The company operates the electric railway system and the electric light and ice plants. The company's embarrassment is due to the failure of the Citizens' Bank.

PINE BLUFF, ARK.—Ford, Bacon & Davis are constructing a combined gas, water and electric plant for the Securities Company, of New York, N. Y.

BISHOP, CAL.—The Bishop Light & Power Company is planning to increase the capacity of its plant to 500 horse-power and will install a water wheel, new machinery and make some line extensions. J. M. Lennon is manager.

FAIRVIEW, CAL.—Plans are being prepared for an electric light and power plant for Fairview.

SAN BERNARDINO, CAL.—Extensive improvements and additions are contemplated by the Lytle Creek Power Company, which will involve an expenditure of about $50,000. Duplicate engines, boilers and dynamos will be installed. W. A. Ball is manager.

SANTA ROSA, CAL.—The Board of Supervisors on July 3 sold the franchise applied for by Frank M. Burris to erect lines over the county roads for the transmission of electricity for lighting and power purposes. Mr. Burris purchased the franchise for $200.

OURAY, COL.—A new electric plant is being installed in the Torpedo-Eclipse mine.

MANITOU, COL.—The Manitou Electric Company is planning to extend its line to the Cave of the Winds and the Grand Caverns, a distance of about 3½ miles. H. H. Van Dusen is superintendent.

SALIDA, COL.—The Salida Light, Power & Utility Company is contemplating increasing the capacity of its power station and will install a new water turbine, one 45-kw General Electric dynamo, and will also construct 6000 feet of pipe line and erect 1½ miles of transmission line. B. Disman is manager.

STEAMBOAT SPRINGS, COL.—The Steamboat Springs Electric Company will install an entire new plant, changing from direct to alternating current at 2300 volts. W. E. Carver is manager.

BRIDGEPORT, CONN.—Beginning with August the price of electricity for lighting purposes will be reduced from 12½ cents to 11 cents per kw-hour, with a minimum charge of $1 a month. All bills of 100 kw-hours per month will be subject to a discount of 10 per cent; for 200 kw-hours per month the discount will be 15 per cent and for 400 kw-hours 20 per cent.

HARTFORD, CONN.—The State Legislature has passed a resolution authorizing the Hartford Electric Light Company to increase its capital stock from $3,000,000 to $5,000,000. A provision in the original resolution, permitting the company to acquire various other corporations, was eliminated on account of the objections which developed to the granting of wholesale powers of merger.

NEW HAVEN, CONN.—The United Illuminating Company announces that the rate for electricity in this city after Aug. 1 will be 11 cents per kw-hour. On bills of 100 kw-hours per month a discount of 10 per cent will be made; for 200 kw-hours per month the discount will be 15 per cent, while for a monthly consumption of 400 kw-hours the discount will be 20 per cent. The minimum charge is $1 a month. The rate is now 12½ cents per kw-hour.

PUTNAM, CONN.—The City Council has entered into a contract with the Putnam Light & Power Company for lighting the streets of the town. The contract calls for 49 arc lamps of 1200 cp and 61 incandescent lamps of 25 cp to cost $416.66 per month.

STRATFORD, CONN.—The citizens of this town are agitating the question of a public lighting service. A special town meeting will soon be held to vote on the proposition.

WASHINGTON, D. C.—Bids will be received until July 23 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing supplies at the Boston Navy Yard as follows: Schedule 82—insulating tape. Schedule 72—Motor-drive outfits at the navy yard, Charleston, S. C.

AMERICUS, GA.—William A. Dodson and associates, who have been granted franchises for the establishment of an electrical power plant and street railway system have financed their enterprise with Pennsylvania capitalists, who subscribed for the entire bond issue. The company is capitalized at $200,000 and will soon apply for a charter. Work will soon commence on the construction of the system.

BRUNSWICK, GA.—The City Council has granted F. D. M. Strachan and associates a 40-year franchise for an electric light and gas plant and electric railway.

CALHOUN, GA.—At an election held recently the citizens voted to issue $12,500 in bonds to construct an electric light plant and for water works improvements.

COLUMBUS, GA.—H. O. Orr, president of the Savannah River Power Company, announces that the Calhoun Falls property will be developed this summer with 35,000 horse-power. Cherokee Falls, also on the Savannah, will be developed this summer and will furnish 10,000 horse-power. Other powers to be developed by the company this summer are: The Hatton Shoals, on the Tugaloo River, 10,000 horse-power; on Broad River, in Georgia, at Anthony Falls, near Elberton, and the 3000 horse-power at Gregg Shoals, will aggregate 58,000 horse-power.

MILLEN, GA.—J. B. McCrary, of Atlanta, is reported to have prepared plans for an electric light plant, water works and sewerage system for Millen.

LEWISTON, IDAHO.—J. L. Bright, manager of the Citizen's Electric Company, is contemplating installing an electric light plant at Harlowton.

ST. MARIES, IDAHO.—Application has been made to the Town Board for a franchise for an electric light plant.

CHRISMAN, ILL.—The City Council has granted a franchise to the Paris & Northern Railway Company. The franchise is for a term of 20 years.

EARLVILLE, ILL.—J. G. Durrell, of Fergus Falls, Minn., has purchased the plant of the Earlville Electric Company. The plant is to be enlarged and improved.

LEBANON, ILL.—C. L. Robinson, city clerk, writes that the Atlas Engine Company, St. Louis, Mo., has secured the contract for furnishing the engine for the electric light plant for $2,000.

MARISSA, ILL.—The citizens are contemplating extending the lighting service of the municipal electric lighting plant and will install 50 new arc lamps and 100 series incandescent lamps of 30 cp and will also introduce meters. J. R. Creighton is manager.

STREATOR, ILL.—The plant of the Illinois Light & Traction Company was recently sold for taxes.

SWANSEA, ILL.—The village is contemplating the erection of a municipal electric lighting plant, for which bids have been asked. Otto J. Keller is village clerk.

EVANSVILLE, IND.—A. L. Swanson has secured the contract for wiring and installing all of the dynamos at the new E. & T. H. depot. Iron conduits will be used. Mr. Swanson is in the market for 700 incandescent lamps and 25 arc lamps. He has also secured the electric contract for the Elenor Ice Company's building in Vincennes and the new Vendome Hotel in this city.

LAFAYETTE, IND.—The Merchants' Electric Light & Heating Company on July 3 awarded contracts for new equipment and the remodeling of its power house, at a cost of $35,000. Joshua Chew secured the contract for additions to the plant and the Lafayette Engineering Company, of Lafayette, for the construction work. Among the new machinery to be installed will be a new 300-hp Hamilton-Corliss engine and a centrifugal pump.

GARY, IND.—Frank Gavitt and associates, of Whitney, have been granted a franchise to construct a street railway here. The franchise is for a term of 50 years.

ROCKVILLE, IND.—The Park County Telephone Company has sold a controlling interest to the Central Union Telephone Company, with division headquarters in Indianapolis. The old stockholders are still a part of the new organization. The new managers are: A. M. Adams, president; W. B. Thomas, secretary, and Russell Burrin, manager.

TERRE HAUTE, IND.—The Commissioners have granted a 50-year franchise to the Terre Haute & Merion Traction Company to construct and operate an interurban line through Vigo County. The company will build a line between Terre Haute and Merion, a distance of 30 miles.

SAPULPA, I. T.—The business men of this city have closed a deal with E. C. Reynolds to build an electric railway in Sapulpa and to the oil fields southeast of this place. Part of the machinery for the power house has been ordered.

BOONE, IA.—The Fort Dodge, Des Moines & Southern Railway Company has filed amendments to its articles of incorporation increasing its capital stock from $2,500,000 to $6,700,000.

DES MOINES, IA.—The Iowa Light, Heat & Power Company and the Des Moines Heating Company have transferred their franchises to W. D. Kinnick. J. S. Polk and G. B. Hippee are the principal stockholders in the two companies.

PELLA, IA.—At an election held July 2 the proposition to grant a 20-year franchise to Z. G. Houck, of Dubuque, Ia., to operate an electric light plant in this place was defeated. The citizens will soon hold an election to vote on the question of establishing a municipal electric light plant.

SIOUX CITY, IA.—The New State Telephone Company has filed amendments to its articles of incorporation increasing its capital stock to $1,000,000.

SIOUX CITY, IA.—Bids will be received until Aug. 6 by the city clerk for lighting the streets with electricity for a period of five, seven and ten years, beginning June 1, 1908. Bids are to be on moonlight and all-night schedule and to provide for not less than 80 arc lamps of 2000 cp and not less than 880 incandescent lamps, bids to be furnished for both 25 and 32-cp lamps. T. W. Bayne is chairman of committee on lights.

CAMPTON, KY.—Milton Garver, of this city, and associates have purchased the plant and holdings of the Campton Fuel & Light Company of this place.

BATON ROUGE, LA.—The officials of the Baton Rouge Electric Company have decided to rebuild the electric plant on the company's site on North Boulevard.

NEW IBERIA, LA.—The Bayou Teche Electric Railway & Light Company has applied to the City Council for permission to locate the new power house 1½ miles below the city limits, at Nelson's Canal. R. H. Fine is manager of the company.

ORONO, ME.—The contract for the construction of the new power house of the Maine State University in this place has been awarded to J. W. Bishop Company, of Boston, Mass.

BALTIMORE, MD.—The Consolidated Gas & Electric Company has awarded the contract for the construction of a concrete power house to be erected at Westport to the Baltimore Terro-Concrete Company, to cost about $170,000.

BALTIMORE, MD.—The Baltimore, Frederick & Hagerstown Electric Railway Company is said to be contemplating extensions into the coal fields of Maryland and possibly West Virginia and Pennsylvania for the purpose of carrying freight to tidewater at Baltimore. The plan is to make the road an extensive freight-carrying line and will involve an expenditure of $25,000,000.

BALTIMORE, MD.—The Baltimore Electric Company has submitted a proposition to Mayor Mahool to furnish electricity for lighting the court house, city hall and city hall annex at the rate of 3 cents per kw-hour, which will mean a saving of about $25,000 a year. The annual cost of the court house plant is estimated at about $32,000, and the company offers to furnish the service for $7,500 for 250,000 kw-hours a year, or a measured service basis of 3 cents per kw-hour.

BRIGHTWOOD, MASS.—The Baush Machine Tool Company is operating its factory by electricity generated at its new power plant.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company has withdrawn its petition recently made to the Board of Selectmen for pole locations in the north part of the town, for the purpose of erecting a high-tension power line between the local power house and the plant of the Franklin Power Company in Turners Falls.

MARLBORO, MASS.—The Marlboro Electric Light Company has submitted a proposition to the Board of Aldermen offering to install and maintain an incandescent lamp on every pole on Florence Street, from Main to Garfield Street, free of charge, and also offers for every arc lamp that the city will place on Main Street to install one at its own expense. The Aldermen voted to give the company permission to place the lamps on Florence Street, and the latter proposition was referred to the committee on street lighting.

WINCHENDON, MASS.—It is reported that the Winchendon Electric Company will soon move from its present site to Centerville, where an excellent water privilege can be secured.

CRYSTAL FALLS, MICH.—Bids will be received until July 25 (readvertisement) by the City Council for erecting an addition to the power station. Robert Munns is city clerk.

ESCANABA, MICH.—The Escanaba Electric Power & Pulp Company, H. P. Lucas and the Weber Gas Engine Company are bidding for the contract to furnish light for the city of Escanaba for a period of 10 years. The Escanaba Electric Power & Pulp Company will erect a power plant on the old Flat Rock mill site. Three turbines with an estimated capacity of 300 horse-power will be installed and provisions made for the addition of others. The dam will be raised to 8 ft. and the water at this head will generate 1300 horse-power. O. L. Huie is directing the work.

GRAND RAPIDS, MICH.—Contracts have been awarded by the Board of Managers for the new electric lighting plant to be installed at the Soldiers' Home, to cost $3,600.

GRAND RAPIDS. MICH.—By the terms of a new franchise which the City of Grand Rapids will grant to the Grand Rapids-Muskegon Power Company will furnish electricity for lighting at 8 cents per kw-hour and for power on a sliding scale. The old franchise of the Grand Rapids Edison Company, which is now controlled by the power company, made the rate 12 cents for lighting purposes. The franchise runs for 20 years and will become effective about Oct. 1. It has been ratified by the company and the ordinance committee of the Council and only remains to be passed upon by the Council. The complete schedule of rates is as follows: Electricity for light, 8 cents per kw-hour; for power according to the amount used per month, 25 horse-power, 2 cents to 3 cents per hp-hour; 25 to 75 horse-power, 1¼ cents to 2 cents per hp-hour; from 75 to 150 horse-power, 1⅛ cents to 1¼ cents per hp-hour; more than 150 horse-power, 1 cent to 1¼ cents per hp-hour. The minimum lighting charge is to be 50 cents a month and for power $1.

LANSING, MICH.—Work has commenced on the construction of the new power house of the Michigan Power Company at the Piatt dam.

LANSING, MICH.—During the fiscal year the city lighting plant earned $78,174.93, and the operating expenses were $32,779.75. The indebtedness is being rapidly paid off despite improvements made. The operating expenses were reduced over $3,000 last year.

PONTIAC, MICH.—Bids are being received for the remodeling of the plant of the Pontiac Light Company. A 250-hp Hamilton-Corliss engine and 150-kw alternating-current generator will be added. The large generator and transformer of the Standard Lighting Company will be utilized and the rest of the Standard plant will be sold.

BRAINARD, MINN.—Repairs to the municipal electric light plant are contemplated.

MANKATO, MINN.—The Knox Construction Company, of Chicago, Ill., it is said will build the railway for the Mankato Electric Traction Company.

JACKSON, MO.—William Paar, city clerk, writes that the contract for constructing an electric light plant and pumping station has been awarded to the Electric & Steam Engineering Company, St. Louis, Mo., for $32,932.

PAGOSA SPRINGS, MO.—The Pagosa Springs Electric Light & Power Company is contemplating the construction of a 100-kw water power plant and erecting two miles of three-phase transmission lines. E. M. Hampton is manager.

OMAHA, NEB.—The Shimer Chase Company is seeking a franchise for an interurban railway to Seymour Park.

ELY, NEV.—The Utah, Nevada & Idaho Telephone Company has acquired several telephone lines in the northeastern part of Nevada and is planning to construct a network of new lines over this part of the state. This company controls the Eureka and Ely line, the W. T. Smith lines in Elko County and another line in Idaho. It will build new lines connecting Salt Lake, Pioche, Austin and Tonapah with Ely.

RENO, NEV.—The City Council on July 9 adopted a resolution prepared by the city attorney, requesting the officials of the Reno Power, Light & Water Company to appear and show cause why the rates for electricity, water and gas should not be materially reduced. The mayor and City Council are trying to secure reduced rates and the company states that it will fight any attempt made by the city officials to reduce its prices.

JERSEY CITY, N. J.—D. A. Reynolds, president of the Coastline Telephone Company, is trying to secure a franchise in this city and has offered to enter into an agreement with the city the terms of the franchise to be as follows: The company agrees to construct a subway system, to be turned over to the city as fast as built, at cost plus 10 per cent and charge the same to "subway account," carrying the same on its books at 4 per cent per annum until paid in rentals or otherwise. The company also agrees to pay the city $200 per year per mile for each duct occupied by its cables, the city to have the right to lease the ducts to any other company using a low potential current, at whatever rate it may determine. The city is to have a discount of 25 per cent on all telephone service over its lines, this discount extending to all parts of its system. The company will spend approximately $1,500,000 in this city.

MADISON, N. J.—The Town Council on July 9 passed a resolution calling for a report on the advisability of changing the lighting system from 1100 to 2200 volts.

MORRISTOWN, N. J.—The Board of Aldermen on July 5 granted the new Morris & Somerset Electric Company a franchise to operate an electric light system in this town. The franchise is for a term of 50 years.

NEWARK, N. J.—The Newark Block Lighting Company has decided to make a new application to the board of public works for a franchise to lay conduits in Lawrence and Market Streets. The Public Service Corporation has asked for a writ of certiorari to review the action of the Newark Common Council, which granted the Newark Block Lighting Company a franchise some time ago.

SOUTH ORANGE, N. J.—The village officials have decided not to wire the village hall for electric fans or light, as the Public Service Corporation has no franchise to supply electricity to consumers in this village.

LA CRUCES, N. M.—B. L. Berkey, manager of the La Cruces Electric Light & Ice Company, writes that the company is now installing a 150-hp boiler in its plant and will install an alternator this fall.

DUNKIRK, N. Y.—A new engine and generator are needed for the Dunkirk water works, and the board of water commissioners is in the market for this machinery. The board is now considering the installation of a steam turbine. Thomas B. Donovan is superintendent.

GLENS FALLS, N. Y.—The Hudson River Power Company has made application to the Public Utilities Commission for permission to issue bonds to the amount of $3,232,000 on a $30,000,000 mortgage. The money is to be used to develop the company's new plant on the Sacandaga at Conklingville.

HERKIMER, N. Y.—The street lighting system of the municipal electric lighting plant is being changed from the open-arc lamps to enclosed arc lamps.

ITHACA, N. Y.—The Ithaca Street Railway Company has authorized a new mortgage to secure an issue of $750,000 in bonds. Part of these bonds will be used from time to time to cover the cost of reconstruction and new equipment, and the balance will be held in reserve to retire prior

liens. The system in the city is to be rebuilt, and 3½ miles of new track is being constructed.

LITTLE VALLEY, N. Y.—The Cattaraugus Cutlery Company has decided to equip its factories with electrical power and has placed a contract with the Allis-Chalmers Company for a 150-kw, three-phase, 440-volt alternator, one belt-driven exciter and an 18 in. x 42 in. horizontal Reynolds-Corliss heavy duty engine, three 30-hp and four 40-hp motors. William W. Hildreth is chief engineer.

LITTLE VALLEY, N. Y.—The two high-speed automatic type engines belted to alternating-current generators in the municipal electric lighting plant are being replaced with a 150-kw, single-phase, Allis-Chalmers alternator and direct-connected 8-kw exciter, both to be driven by an 18 in. x 42 in. horizontal Reynolds-Corliss engine of heavy duty type. One of the high-speed units has been disposed of, while the other will be held for reserve and the light day loads. A new 6½ in. x 18 in. horizontal tubular boiler has been purchased of McEwen Brothers to be placed in the plant. C. P. Rice is superintendent.

NEWPORT, N. Y.—The Newport Electric Light & Power Company has applied to the Public Utilities Commission for permission to issue first mortgage bonds to the amount of $50,000. The proceeds will be used to rebuild the dam of the company which recently gave away. The company also asks for consent to supply the villages of Poland and Cold Brook, in Herkimer County, with electricity.

NEW YORK, N. Y.—The Long Acre Electric Light Company has been assigned space in the subway conduits for its electric conductors for furnishing electricity for light, heat and power in this city. The company proposes to proceed immediately with the building of its plant.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, until July 22, for installing electric equipment in addition to and alterations in Schools 14 and 29, Borough of Manhattan.

NIAGARA FALLS, N. Y.—The Niagara Falls Hydraulic & Power Company has filed application for permission to erect its new power house below the bank.

NORTH TONAWANDA, N. Y.—The Common Council has awarded the contract for street lighting to the Tonawanda Power Company for $57.50 per lamp per year for a term of three years. This is a reduction of $12.50 a lamp from the price paid under the last contract with the company, which was for two years. The new schedule goes into effect Aug. 1.

NORWICH, N. Y.—The State Gas and Electric Commission has finally granted the Oriskany Hydro-Electric Company permission to carry on business in the counties of Oneida, Madison and Chenango. The balance of the stock is to be issued when the charter is amended to cover all towns where consents have been granted. The company proposes to build an electric transmission line and electric railway from the terminus of the Utica & Mohawk Valley line, at Clinton, south to Norwich. E. H. Risley, of Utica, is one of the promoters.

OSWEGO, N. Y.—Thomas N. Devine, city clerk, writes that plans are now being prepared for the power house to be erected in connection with high dam. For further information address F. W. Ormsby, superintendent, water works.

UTICA, N. Y.—The Herkimer County Light, Heat & Power Company has been merged with the Utica Gas & Electric Company. By this consolidation, the latter company takes in all the river towns in Herkimer County and extends as far north as Dolgeville.

WILMINGTON, N. C.—The Tidewater Power Company has filed amendments to its charter increasing its capital stock from $700,000 to $1,200,000.

ARLINGTON, OHIO.—The city of Arlington has rejected all the bids for the $10,000 lighting bonds. The issue will be readvertised.

ATLANTA, OHIO.—A special committee has been appointed by the City Council to consider the question of establishing and operating a municipal electric light plant.

CLEVELAND HEIGHTS, OHIO.—Bids will be received until Aug. 6 by William G. Phare, village clerk, (Fairmount P. O.) for furnishing material and lighting certain streets and roads in Euclid Heights allotment.

COLUMBUS, OHIO.—A special meeting of the stockholders of the Cuyahoga Telephone Company will be held July 22 for the purpose of authorizing an increase of the capital stock of the company by $500,000.

TOLEDO, OHIO.—New bids will be received until July 26 by the county auditor, separately or as a whole, for all labor and material required in the building of a heating and power house, including stack for the same, at the Lucas County Infirmary; also at the same time for installing in the heating and power house, boilers, dynamos, machinery and appurtenances, conduits and piping outside of said power house. The estimated cost is $27,000. J. W. Kerr is chairman of county commissioners.

KLAMATH FALLS, ORE.—Building operations have been commenced by the Southern Pacific Railway Company at Spencer, on the Klamath River, for the construction of a large hydro-electric plant. It is reported that the company intends to utilize the power for operating its trains on the Sacramento, Siskiyou and Klamath divisions. The plant is located about 18 miles from this city.

PANAMA.—Bids will be received until July 30, at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., for electric fan motors, etc. Blanks and general information relating to this work can be obtained at the above office, referring to circular (No. 376) or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La.; 1086 North Point Street, San Francisco, Cal., and 410 Chamber of Commerce Building, Tacoma, Wash.; also from chief quartermaster, Chicago, Ill.; depot quartermaster, St. Louis, Mo.; depot quartermaster, Jeffersonville, Ind., and chief quartermaster, Atlanta, Ga. D. W. Ross is general purchasing officer.

LEBANON, PA.—It is stated that the Pennsylvania Steel Company, owners of the Cornwall ore mines, five miles from Lebanon, purpose erecting a modern electrical plant in Lebanon to supply electricity for the mines in the Cornwall hills, and also for operating the electric railways in this territory. The new plant will have 2000 horse-power capacity, arrangements having been made for the installation of three 750-kw engines, all of which will be operated with the gas from the coke ovens.

SCRANTON, PA.—Anticipating the ordinance providing for the placing of wires underground, the Scranton Electric Company has commenced the work of placing its wires in underground conduits in the central part of the city.

WEST NEWTON, PA.—At a meeting of the Town Council held July 5, arrangements were made for the sale of the local municipal electric light plant to the Pittsburg, McKeesport & Westmoreland Street Railway Company. The company will furnish electricity for lighting the town and also contemplates enlarging the plant to furnish electricity to operate the electric railway which is to run from this place to Irwin. The town began to operate the plant in 1893, but the service has been unsatisfactory as well as expensive. Work on the construction of the electric railway in this town will commence soon.

WILKES-BARRE, PA.—Joseph Dunn is reported interested in a new lighting company recently formed here, which is about to apply for a charter.

WILKES-BARRE, PA.—The Wilkes-Barre Subway Light & Power Company has applied to the Secretary of State for a charter. Dr. Lewis Edwards, county treasurer, Fred Darte and Reese Lloyd are among the incorporators. It is stated that the company does not contemplate building a plant of its own to generate electricity, but will purchase electrical power, probably from the Laurel Line Company.

PONCE, P. R.—The Ponce Electric Company will extend its tracks to the new government wharf and will install a new water-tube boiler, a water softening plant and purchase two motor flat cars.

PROVIDENCE, R. I.—The directors of the Providence Telephone Company have voted to increase the capital stock of the company from $1,600,000 to $2,100,000, the proceeds of which will be used to increase the capacity of the system and improve the service. The company has been granted permission by the Town Council to lay conduits on Hope Street and Poppasquash Road.

ROCKINGHAM, S. C.—The Federal Construction Company is building the hydro-electric plant of the Rockingham Power Company. Thomas F. Richardson is resident manager of the company.

GARY, S. D.—The question of erecting an electric light plant is under consideration.

PLATTE, S. D.—John Alsher, of Wagner, has been granted a franchise to construct and operate an electric light plant in this place.

CLARKSDALE, TENN.—The Clarksdale-Colliersville-Covington Interurban Railway Company has filed an application for a charter. The capital stock of the company is $50,000, and the incorporators are R. F. Tate and others.

MARYVILLE, TENN.—A contract has just been closed by the lighting committee of the Maryville Council with the Rockford Electric Company for lighting the streets of the town. The contract provides for thirty-five incandescent lamps and is for the term of one year, at the rate of $50 per month.

MONTEREY, TENN.—The citizens have voted to issue $25,000 in bonds for the construction of an electric light plant and water works system.

BAIRD, TEX.—The local electric light plant has been shut down, and it is reported that a new company will be organized with ample capital to put in an up-to-date plant.

BROWNSVILLE, TEX.—Surveys and plans are being made for an electric plant and water works system.

EL PASO, TEX.—Plans have been prepared by the El Paso Electric Company for the construction of a large electric power plant on the Rio Grande River at El Paso, for which a site has recently been purchased.

EL PASO, TEX.—Extensive additions and improvements are being made to the power station of the El Paso Electric Railway Company. Two 500-kw turbo-alternators, one 300-kw motor generator and boilers of 2000 horse-power and condensers are being installed.

GALVESTON, TEX.—The capacity of the power plant of the Galveston Electric Company is being increased by the installation of a 300-kw alternating-current generator and a 500-hp boiler.

GONZALES, TEX.—The Gonzales Electric Light & Power Company is contemplating installing additional machinery that will double the capacity of the plant.

HAMLIN, TEX.—It is reported that an electric light plant will soon be erected in this place.

HOUSTON, TEX.—The Houston Electric Company has recently installed a Hamilton-Corliss engine of 875 horse-power direct connected to a Crocker-Wheeler generator.

SHERMAN, TEX.—The City Council has granted the Sherman, Whitesboro & Gainesville Railway a franchise over Pecan and Walnut Streets. It also granted the company the right to furnish electricity for lighting and power purposes.

STAMFORD, TEX.—The Stamford Gas & Electric Company is making improvements to its plant and installing new machinery. H. W. Wright, of Shreveport, La., has charge of the work.

TERRELL, TEX.—A. M. Wooly, city secretary, writes that the citicens on July 9 voted to issue $15,000 in bonds for constructing an electric light plant.

TOYAH, TEX.—The Toyah Electric Light Company has been organized to operate an electric light plant in Toyah.

WHARTON, TEX.—H. P. Phiel, of Fredricksburg, Tex., is interested in the construction of an electric light plant in this place.

STARKSBORO, VT.—Messrs. Blackwell and Chandler, of Brandon, have been in town investigating the water privilege owned by Baldwin, Carpenter and Verper Thompson with a view of purchasing the same for the purpose of developing a hydro-electric plant.

CHEHALIS, WASH.—Arrangements are being made by San Francisco capitalists to erect a large electric power plant on Packwood Lake, a few miles distant from Cora. H. K. Green has charge of the work.

NORTH YAKIMA, WASH.—The franchises and other assets of the Inter-Valley Traction Company has been taken over by the Yakima Valley Transportation Company. It is the intention of the new company to rush the road to completion. George Rankin, president of the Yakima Valley Trust Company, is interested in the company.

SPOKANE, WASH.—A franchise has been granted by the County Commissioners to the Spokane Traction Company to build a street railway line across Monroe Park, north of the city.

TACOMA, WASH.—We are informed that no bids were opened on July 3 for the proposed municipal power plant (steam, gas or hydraulic). New bids will be received until July 31 by Owen Woods, commissioner of public works. The plant will have a capacity of not less than 4000 horsepower. Contractors are to furnish their own plans.

ASHLAND, WIS.—It is reported that bids are wanted Aug. 1 for a municipal electric light plant.

MENOMINEE, WIS.—This town will shortly have a new electric light plant. During the last three years the streets and business places have been lighted by electricity furnished by the plant of the Wisconsin Sugar Company, and light has been available only from dark until midnight, from Oct. 1 to Feb. 1. The new plant will give 24-hour service and many local concerns have decided to operate their plants with electricity.

MILWAUKEE, WIS.—Under a new law passed by the Legislature, Mayor S. M. Becker will have the appointment of a commission of five members to take charge of the erection and management of the municipal electric lighting plant. The matter is now in the hands of the Board of Public Works, assisted by an advisory committee of aldermen. The mayor once appointed such a commission, but the city ordinance under which he acted was found insufficient to make the body legal.

OSHKOSH, WIS.—Richard H. Hackett has been appointed receiver of the Winnebago Traction Company.

LANDER, WYO.—The Lander Electric Light & Power Company is contemplating making improvements and additions to its plant and system, which will involve an expenditure of about $15,000. E. Amoretti, Jr., is manager.

GRAND FORKS, B. C.—The City Council is considering the question of making a contract with the West Kootenay Power & Light Company to furnish the city with electrical power.

CHATHAM, ONT.—This city is making arrangements to apply to the Ontario Railway and Municipal Board for permission to submit a by-law to the people providing for an expenditure of $15,000 for extensions to the electric light system.

OTTAWA, ONT.—The Civic Electric Commission is negotiating with the Ottawa Electric Company to purchase the equipment now used by the company under its street lighting contract, and to take over the contract for the unexpired term. The commission recommends that the city solicitor be instructed to prepare an offer to the Ottawa Electric Company of $24,000, the amount of the valuation for the hangers, wires, lamps and apparatus used by the company for street lighting purposes. Also that in case the company does not accept the offer, that the city solicitor prepare the necessary notice appointing the official arbitrator to determine the amount to pay the company.

PETERBORO, ONT.—The negotiations entered into some time ago by the city with the Peterboro Light & Power Company for the purchase of the electric light business has fallen through. The company refuses to go any further with the matter, unless the Ontario Hydro-Electric Power Commission agrees to sanction any agreement entered into by the ratepayers and the company, which the City Council will not agree to. The Council has decided to apply to the Hydro-Electric Power Commission to acquire water power privileges and construct the necessary works to supply cheap power.

ST. CATHERINES, ONT.—The Niagara, St. Catherines & Toronto Railway is contemplating building an extension during the present season from this place to Niagara-on-the-Lake, Welland and Grimsby Park. The electric line is also to be extended from Niagara Falls to Fort Erie.

DAWSON, Y. T.—The Yukon Milling, Dredging & Power Company has been granted water rights on the Klondike River, three-quarters of a mile above Rock Creek. The grant is for 5000 inches and for a term of 20 years. The company proposes to develop the water power and to transmit electricity for commercial purposes.

Company Elections.

BALTIMORE, M. D.—At the annual meeting of the Consolidated Gas, Electric Light & Power Company held recently, the stockholders elected the following directors: Charles Adler, Alexander Brown, Anthony N. Brady, S. R. Betron, Charles T. Crane, John B. Dennis, Charles H. Dickey, Francis H. Hambleton, Thomas J. Hayward, Fairfax S. Landstreet, Ferdinand C. Latrobe, Alten S. Miller, S. Davies Warfield, Frederick W. Wood, Thomas J. Shryock and Charles M. Cohn.

MT. WASHINGTON, MD.—At a meeting of the directors of the Mt. Washington Electric Light & Power Company, held June 25, the following officers were elected: Thomas W. Offutt, president and general manager; Alten S. Miller, vice-president, and Harry J. McIntyre, secretary and treasurer.

New Industrial Companies.

THE BERKSHIRE ELECTRIC COMPANY, of North Adams, Mass., has been incorporated with a capital stock of $10,000 by W. F. Waterman, of Boston, and Joseph Lyons, of North Adams. The purpose of the company is construction and allied work in the building of electric railways.

THE ELECTRIC DEVELOPMENT & CONSTRUCTION COMPANY, of Portland, Me., has been incorporated with a capital stock of $1,000,000 by James E. Manter, Clarence E. Eaton, Charles D. Fullerton and Millard W. Baldwin, of Portland, Me.

THE OLSON-BOETTGER ELECTRIC MANUFACTURING COMPANY, of St. Paul, Minn., has been incorporated with a capital stock of $25,000 by H. C. Boettger, J. L. Olson and H. G. Olson.

THE RUMSEY ELECTRIC COMPANY, of Camden, N. J., has been incorporated with a capital stock of $125,000 by G. A. Rumsey, Sr., of Salem, N. J.; W. T. Thomas, of Glenside, Pa., and C. L. Butler, of Philadelphia, Pa. The company proposes to manufacture and deal in electrical machinery devices and goods.

THE STEVENS MANUFACTURING COMPANY, of Woodbury, N. J., has been incorporated with a capital stock of $50,000 by F. Stevens, G. F. Stevens and F. W. Wanderer, of Philadelphia, Pa. The company proposes to manufacture electrical supplies, etc.

THE SOUTHERN INDIANA ELECTRIC COMPANY, of New Albany, Ind., has been incorporated by Charles D. Knoefel, Frank Beaucond, of New Albany, Robert S. Donaldson and Philip S. Pogue, of Louisville, Ky. It is the intention of the company to engage in the manufacture of electrical appliances, among which will be a terminal box for the protection of cables. The capital stock is placed at $5,000.

THE YETMAN TYPEWRITER TRANSMITTER COMPANY, of New York, N. Y., has been formed to manufacture transmitting typewriters, telegraphic transmitters, automatic telegraph machines, etc. The capital stock of the company is $1,500,000 and the directors are: Charles E. Yetman, Samuel Johnston, William M. Williams, and Gabriel Morton, of New York, N. Y., and James J. Stevenson, of Oshkosh, Wis.

New Incorporations.

SAN FRANCISCO, CAL.—The United Water & Power Company has filed articles of incorporation, with a capital stock of $2,500,000. The company proposes to conduct a system of water supply and transmit electricity to this city. The directors are Arthur L. Pease, James D. Stewart, Balfour D. Adamson, J. L. Gould and Charles H. Town.

MARSHALL, ILL.—The Charleston, Westfield, Marshall & Terre Haute Interurban Railway Company has been incorporated by James Dawson, William B. Scholfield, Seymour Hurst, Norman Bennett, W. L. Biggs, M. L. Briscoe, W. R. Patten, T. M. Berkeley and E. T. Pinnell.

GREENFIELD, IND.—The Spring Town Telephone Company has been incorporated with a capital stock of $180 by James Parish, Frank Carrier and others.

ELKADER, IA.—Articles of incorporation have been filed for the Highland Telephone Company, with a capital stock of $800, by B. M. Benson and others.

JEFFERSON, IA.—The Jefferson Mutual Telephone Company has been incorporated with a capital stock of $10,000 by M. R. Cline and others.

MANKATO, MINN.—The Mankato Electric Traction Company has been organized, with W. L. Hixon, president; Fred Kron, vice-president; W. D. Willard, secretary and treasurer, and H. E. Hance, superintendent.

NETCONG, N. J.—The Willsbrook Electric Light Company has been incorporated for the purpose of manufacturing electricity for lighting.

heating and power purposes. The capital stock of the company is $30,000 and the incorporators are J. S. Kennedy, H. H. Neiden and D. M. Cooke, of Stanhope.

GUTHRIE, OKLA.—The Enid, Blackwell & Osage Interurban Traction Company has been chartered, with a capital stock of $1,000,000, to build a railway from Enid to Pawhuska, a distance of 85 miles. The incorporators are: George W. Bear, Frank Bradfield, S. I. Hudkins, John R. Clover and Guy S. Manatt, all of Enid.

AUSTIN, TEX.—The Texas Interurban Company has been chartered for the purpose of building a system of interurban electric railways, with Austin as the center. The company is capitalized at $400,000, and the incorporators are: Thomas Moore, of Elizabeth, N. J.; Ephraim Miller, of White Plains, N. Y.; Henry M. McKay, of Hempstead, N. Y.; C. P. Scrivener and S. M. Posey, of Austin. It is announced that the company will soon commence the construction of an interurban line from Austin to Lockhart, a distance of about 30 miles.

STEPHENVILLE, TEX.—The Stephenville Light & Water Company has been incorporated, with a capital stock of $40,000, by C. H. Bencini, D. H. Burroughs and W. D. Head.

WACO, TEX.—The Home Light & Power Company has been incorporated, with a capital stock of $25,000, by C. R. Boyton, M. L. Lane and others.

SEATTLE, WASH.—Articles of incorporation have been filed for Puget Sound International Railway & Power Company, of Portland, Me., with a capital stock of $2,250,000, by J. H. Drummond, G. M. Drummond, W. G. Chapman, of Portland, Me.; Benjamin Joy, J. S. Lovering, P. L. Warren, A. K. Todd and J. E. Rousmaniere, of Boston, Mass.

SPOKANE, WASH.—Articles of incorporation have been filed for the Panhandle Electric & Power Company, with a capital stock of $1,000,000. The directors are S. W. Payne and others.

BURKHARDT, WIS.—The Burkhardt Mill & Electric Power Company has been incorporated, with a capital stock of $50,000, by Frank P. and C. Burkhardt.

Legal.

PROHIBITION OF CONTRACTS OR COMBINATIONS IN RESTRAINT OF INTERSTATE COMMERCE AND IN VIOLATION OF THE ANTI-TRUST ACT.—In an action to recover treble damages from the defendant company under section 7 of the act of Congress, entitled "An act to protect trade and commerce against unlawful restraints and monopolies," the complaint alleged that the defendant was engaged in purchasing and contracting for the purchase of window glass from the manufacturers for certain jobbers and wholesale dealers doing business in different states, who owned and controlled practically all of defendant's stock; that such dealers comprised over 75 per cent of all those in the United States, and sold more than 75 per cent of the window glass sold therein; that on a certain date the defendant entered into a combination and agreement with them and with a manufacturer which owned and operated factories in different states and manufactured 70 per cent of all the window glass made in the United States, by which the defendant and the dealers agreed to buy window glass from no other manufacturer unless at a materially lower price, and the manufacturer agreed to sell to no other dealers, except at higher prices than it charged them. The agreement limited the quantity of glass to be purchased by each dealer and gave them the power to fix arbitrarily excessive and unreasonable rates which were to be charged to retail dealers, which prices the wholesale dealers were to maintain under the penalty of heavy fines. It was held that the declaration charged a contract or combination in restraint of interstate commerce, in violation of the statute mentioned, which, as construed by the Supreme Court of the United States, makes unlawful any contract or combination in restraint of interstate trade or commerce, and not merely those which are in unreasonable restraint of trade and therefore illegal at common law. "It was obviously designed," said the court, "to destroy or minimize competition between certain wholesalers and jobbers, alleged to be 75 per cent of the whole number so engaged in the United States, and, in the language of the Supreme Court, 'to destroy or restrict free competition in interstate commerce is to restrain such commerce.'"

LIABILITY OF CASUALTY COMPANY TO TELEPHONE COMPANY ON POLICY INSURING LATTER AGAINST LOSS FROM LIABILITY FOR DAMAGES.—A policy issued by a casualty company insured a telephone company against loss from liability for damages on account of bodily injuries accidentally suffered by any person as a result of the negligence of the telephone company. The policy limited the casualty company's liability arising from the death of or injury to one person to $5,000, provided for notice to the casualty company of any injury or claim for damages therefor, and prohibited the assured from making any settlement, incurring any expense or interfering in any negotiations for settlement or in any legal proceeding without the consent of the casualty company. While the policy was in force an employe of the telephone company was killed at Owensboro, Ky., by coming in contact with a telephone wire which had been negligently allowed to rest upon an electric light wire. The telephone company gave notice of this accident to the casualty company and an action, which was brought by the administrator of the deceased employe, was defended by counsel employed by the casualty company. The action resulted in a verdict for $12,000 in favor of the plaintiff. During the course of the trial the telephone company had paid the costs of the plaintiff and the casualty company had incurred considerable expense. The casualty company attempted to deduct from the $5,000 due the telephone company under the policy the amount which it had expended in connection with the defense and the telephone company claimed to be entitled to the entire $5,000 and, in addition, the sums which it had paid out in connection with the case. It was held that, construing the policy as a whole, the casualty company was liable, in addition to the $5,000, for the costs and expenses which the telephone company had been compelled to pay. A policy of insurance prepared with much care for the interests of the insurer should be construed favorably to the other party, if the language leaves the matter in doubt. New Amsterdam Casualty Company vs. Cumberland Telephone & Telegraph Company, U. S. Circuit Court of Appeals, 152 Fed. Rep. 961.

RAILROAD COMPANY CANNOT KEEP TELEGRAPH COMPANY FROM ERECTING ITS POLES AND WIRES ALONG THE RAILROAD RIGHT OF WAY.—The same principle which justifies a railroad corporation in condemning a right of way over the lands of private individuals in the first instance will stand for the subsequent condemnation of a right of way by a telegraph company against the railroad. This is an old and just proposition of law recently reiterated by the United States Circuit Court in a case involving an attempt by the Atlantic Postal Telegraph Cable Company to acquire a portion of the right of way of the Georgia Railroad & Banking Company, between the cities of Augusta and Atlanta, wherein to erect its poles and wires, and an effort on the part of the railroad company to keep the right of way entirely for its own use on the plea that the installment of the telegraph line would interfere with its business. In the proposed line of the telegraph company it was planned that the poles would not be over 20 feet in height and that they should be removed at least 20 feet from the end of the nearest cross-tie. The railroad company declared that at certain points its right of way was far too narrow to permit of the execution of this plan. The court, however, was of the opinion that this statement applied at those attenuated points on the Georgia line where it seemed to enjoy nothing but roadbed, and that contiguous territory upon which a pole might rest would probably be found in the neighborhood. The railroad company argued against the admission of the telegraph company upon its domain that there were many curves in the road and that, at these points, the wires would have a tendency to pull the poles down upon the tracks, which argument was met by the court in this wise: "In railroad construction and maintainance curves are not novel, and it would seem easy enough by proper bracing to protect the roadbed and track." The railroad company then complained that the Western Union already was in possession of part of its right of way putting it to the same use as that contemplated by the Atlantic Company and said, in effect, that one was enough. But the court again favored the telegraph company in holding that because one telegraph company had secured a prior occupancy for its lines could not be made a ground upon which to hold that other companies might not thereafter institute additional lines. The existence of competing lines along the same right of way was a means of insuring fair service to the public. The president and general manager of the Southern railroad testified that during a sleet storm of 1905 several hundred telegraph poles were strewn across the various lines of railroad in his section, causing great delay to the trains, and that telegraph poles, when in close proximity to a railroad track, were often caused to fall by taking fire. "These conditions, while obviously distressing," said the court, "would in this day scarcely enbarrass the wonderful profession of engineering, which has woven the gigantic suspension bridge, constructed the transcontinental railway, conducts mighty steamships over the shallows where Israel escaped and Pharaoh perished, and even now is rushing to completion that Isthmian canal, which for more than 400 years has quickened the imagination of the discoverer, the geographer and the statesman." It was held that none of the grounds advanced by the railroad company was sufficient to warrant the court in enjoining the telegraph company from proceeding with the work of erecting the proposed line. Georgia Railroad & Banking Company vs. Atlantic Postal Telegraph Cable Company, 152 Fed. Rep. 991.

Obituary.

MR. J. MENASCO.—Advices from Monroe, La., state that Mr. John Menasco, the city electrician, was struck by a train there on July 2 and instantly killed. The body has been sent to his daughter at Bisbee, Ark., for interment. He had held his position at Monroe for the last four years, and was about 40 years of age.

MR. H. L. CARTER.—Advices from Harrisburg, Pa., of July 15, report the death there of Mr. Henry L. Carter, 50 years old, the president of the York Haven Power & Paper Company, of a stroke of apoplexy at his home. He leaves a widow and eight children. The York Haven plant is a modern and interesting one, and has been described in our pages during the past year.

MR. N. HAMILTON.—The death is announced at Hot Springs, Ark., of Mr. Nandaior Hamilton, of Harrisburg, Pa., aged 50 years. He was quite active in local Democratic politics. He was largely interested in the Paxtang Electric Company, was one of the organizers of the Southwest Missouri Electric Railway system, and was president of the Union Telegraph & Telephone Company, operating exchanges in Rock Island, Ill., and Davenport, Ia.

MR. RICHARD F. GOTSCHALK, president of the Columbus Street Railway and Light Company, of Columbus, Ind., was killed July 10. While endeavoring to fix a trolley wire he slipped from the ladder which had been placed against the guy wire and fell into the street. Mr. Gotschalk was identified with the Columbus Company and its constituents for a number of years, going to Columbus from Chicago in 1889. He was 42 years of age and is survived by a widow and two children.

Personal.

MR. J. A. STANTON, of Cincinnati, Ohio, has been made secretary and treasurer of the Mt. Carmel, Ill., Gas & Electric Company.

PROF. V. KARAPETOFF, of Cornell University, has written a textbook on "Experimental Electrical Engineering," which will be published this fall.

MR. A. H. WALTON, of the British Thomson-Houston Company, is now in this country and has been visiting various plants in order to study the latest American developments in power plants.

PROF. H. H. NORRIS, of Cornell University, has prepared for the use of students a work entitled "An Introduction to the Study of Electrical Engineering," which will issue from the press Aug. 15.

MR. A. W. ZAHM, who was formerly business manager of the People's Gas & Electric Company, of Mason City, Ia., has been appointed manager of the Fort Dodge, Ia., Light & Power Company.

MR. GUY W. TALBOT, vice-president and general manager of the Corvallis & Eastern Railroad, has resigned to take the position of vice-president and general manager of the Oregon Electric Railway.

MR. CHARLES H. MERZ, of London and Newcastle-upon-Tyne, England, consulting electrical engineer, announces that the style of his firm will hereafter be Merz & McLellan. His new associate is Mr. W. McLellan.

MR. B. W. TRAFFORD, manager of the Chesapeake & Potomac Telephone Company, Baltimore, Md., has been appointed general manager of the Michigan State Telephone Company, with headquarters at Detroit.

MR. A. S. KALENBORN, formerly assistant electrical engineer of the California Gas & Electric Corporation, has charge of the newly established offices of F. G. Baum & Company, 497 Arcade Annex, Seattle, Wash.

MR. W. J. ECK has been appointed electrical engineer of the Southern Railway Company, with headquarters at Washington, D. C., vice Mr. Gray W. Johnston. The road's superintendent of telegraphs is Mr. C. P. Adams.

MR. MARSDEN J. PERRY, vice-president of the Union Trust Company, of Providence, R. I., and past president of the National Electric Light Association, has been elected vice-president of the Night and Day Bank of New York.

MR. J. S. VIEHE, formerly with the Southern Power Company, has been appointed electrical engineer for the Federal Construction Company, which is building the dam, power house and transmission line of the Rockingham Power Company, of Rockingham, N. C.

DR. ALFRED BERLINER, director of Siemens & Halske, etc., is on a visit to this country, and is making a trip around the world. He will proceed next to Japan, and thence across Siberia. Dr. Berliner is familiar with this country, having spent some few years in Chicago.

MR. HENRY C. HAZZARD, of New York City, has been appointed chief clerk of the division of light, heat and power of the second district (up state) Public Utilities Commission. He was the secretary of the old State Commission of Gas and Electricity at a salary of $3,000.

MR. F. C. LEWIS, superintendent of the Denison, Tex., exchange of the Southwestern Telephone Company, has resigned and accepted a position in the engineering department of the Home Telephone Company, of Los Angeles, Cal. Mr. T. G. Wilkins will succeed Mr. Lewis.

DR. N. M. HOPKINS, electrical engineer for consolidated power plants, Department of the Navy, contributed recently to the *Journal of the American Society of Naval Engineers* some interesting data on standard lighting protection for power plant chimneys at U. S. yards. It has now been issued in pamphlet form.

MR. RAYMOND H. SMITH, superintendent of the Bridgeport division of the Connecticut Railway & Lighting Company, has tendered his resignation is to take effect as soon as his sucessor is appointed. Mr. Smith has accepted the position of superintendent of the Albany & Hudson Electric Railway & Lighting Company, of Hudson, N. Y.

MR. ANTHONY J. BRADY has been elected a director of the British Columbia Copper Company, to succeed Colonel John Weir, who resigned because of ill-health. Mr. Brady sailed suddenly for England last week, in connection, it is believed, with his large interests in the American Tobacco Company and its English allies, now under fire of litigation with the government legal authorities in Washington.

MR. GEORGE W. MARTIN, formerly editor of the *Electrical Age*, and latterly with the engineering department of the New York Edison Company, has been appointed by Ford, Bacon & Davis as assistant to the resident engineer for the construction of a combined gas, water and electric plant at Pine Bluff, Ark., for the Pine Bluff Water & Light Company.

MR. HERBERT S. WHITON, chief engineer of the Ponce Electric Company, of Ponce, Porto Rico, has been appointed manager of the company in place of Mr. Gardner Rogers, who is returning to the Boston office of Stone & Webster. Mr. James B. Walker, of the Boston office, has been appointed assistant treasurer at Ponce, to take the position of Mr. William H. Stone, who is leaving the company to become manager of the Mayaguez Light & Power Company, of Mayaguez, Porto Rico.

MR. H. M. HIRSCHBERG, of the Excello Arc Lamp Company, has gone on a two months' trip to England and Germany and through the continent generally in order to study lighting conditions and to make arrangements for a new line of lamps next year. The Western traveling representative, Mr. C. W. Armstrong, will be in New York for a number of days in connection with work at the head office. Mr. O. Baerwinkel has returned from an extensive tour through Canada, where he visited the largest power and lighting plants in the provinces of Manitoba and Ontario.

MR. H. MILLIKEN, who recently joined the engineering staff of W. S. Barstow & Company, New York City, leaves this week for their Portland, Ore., office, where he will be permanently located as resident electrical engineer. Graduating from the Massachusetts Institute of Technology with a degree of E. E. he entered the engineering department of the General Electric Company, at Schenectady, later taking a post graduate course at the Case School of Applied Science, Cleveland, Ohio. For the last two years he had been identified with the operating department of the New York Edison Company, prior to his association with the Barstow staff.

A BROOKLYN NIGHT.—On Monday, July 8, at the Brighton Beach Hotel, the contract department of the Edison Electric Illuminating Company, of Brooklyn, had as its guests at dinner, W. W. Freeman, W. F. Wells, P. A. Atkinson and J. F. Becker, Jr., the vice-president, general superintendent, treasurer and general agent of the company. Mr. J. F. Becker, the able contract chief, acted as toastmaster. Toasts were responded to briefly by some six or eight of the diners, after which Mr. W. W. Freeman, through his thoughtfulness and generosity, made it possible that this dinner become an annual affair. After the banquet the open doors of the Music Hall swallowed officers and men, where a splendid bill was thoroughly enjoyed by all.

MR. PUTNAM A. BATES, under whose direction a large consignment of apparatus has just been shipped to Manila, P. I., for the electrical equipment of Fort Wm. McKinley, has closed contracts for a complete electric generating plant, storage battery, steam heating and ventilating installation for the Sevilla Home and Hospital now in the course of construction in the Borough of the Bronx. His services have also been engaged by the architects in charge of the Wadsworth Atheneum, of Hartford, Conn., to which institution the Colt estate, of Hartford, and Mr. J. P. Morgan have recently given liberal sums for the erection of new wings to contain art galleries and museums. The heating, ventilating and lighting systems for these buildings are now being designed by Mr. Bates.

MR. W. J. WILGUS, vice-president of the New York Central & Hudson River Railroad Company, has tendered his resignation, to take effect Oct. 1. The following is the official announcement issued by the company: "Mr. Wilgus has several times during the last two years suggested his desire to retire from his official connection with the service of the company, but the great work of changing from steam to electric power in the electric zone and the reconstruction of the Grand Central terminals made it almost impossible for the road to comply with Mr. Wilgus' wishes. The initial installation of electricity having been completed and the practicability and success of handling the business of the road by the new power having been fully demonstrated by months of successful operation, Mr. Wilgus renewed his request to be relieved at as early a date as practicable, suggesting July 1 as the date. At the earnest request of President Newman, however, Mr. Wilgus has consented to remain in his present position until Oct. 1, and with this understanding his resignation, effective on that date, was reluctantly accepted."

MR. PETER COOPER HEWITT has transferred his energies from the electric and automobile fields and has lately been working on high-speed marine craft of the "gliding" type, on the plan of a flying machine, and capable of 60 miles an hour. In the model from each corner of the frame there are dropped into the water perpendicular steel arms. These arms extend 18 inches below the bottom. To the arms are fastened steel planes, having a slant upward in front of about 1 in 8. The bottom submerged planes have 2 square feet of surface and those above it are larger. The total supporting surface of the four principal planes, therefore, is 8 square feet. The motor is set forward and the single screw turns just back of the front sets of planes. On either side of the shell is a gasoline tank. In operation the screw driving or pulling the craft forward forces the slightly slanted planes through the water and, on account of their slant, the craft is forced upward. The greater the speed the higher the craft rises. When it has reached a speed which forces the topmost vanes out of the water, or partly out, part of the supporting surface is lost and the craft settles lower, this principle constantly operating to maintain a perfect level for the shell at a given distance above the surface of the water.

Trade Publications.

MECHANICAL DRAFT.—With this title the Green Fuel Economizer Company, Matteawan, N. Y., has issued a pamphlet describing and illustrating the application of mechanical draft in connection with economizers.

COOL THOUGHTS.—"Something Cooling for a Hot Day" is the title of an attractive 16-page folder designated as Bulletin No. 90, recently

issued by the B. F. Sturtevant Company. It describes various types of electric propeller fans and illustrates their application.

TRUMBULL CHEER for July is full of good things, including a monthly calendar for the desk. The Trumbull Electric Manufacturing Company's factory at Plainville, Conn., is shown, besides several excellent illustrations of switches. Price lists of the switches made by this company are also given.

"PLANT ECONOMY" is the title of a pamphlet by Mr. H. P. Dennis, M. E., an authority on power plant equipment. It deals with the important uses of automatic recording instruments and is issued by the Bristol Company, of Waterbury, Conn., which will send copies of the bulletin to any person interested.

"PAISTERY."—Bulletin No. 44, of the H. T. Paiste Company, Philadelphia, Pa., relates to bushings, rosettes, fusible hanger boards for multiple arc lamps, taplets, etc. These goods are well illustrated and the prices given. June being the brides' month, the front cover has an illustration of a young lady in bridal garments.

WESTINGHOUSE LAMPS.—A 38-page pamphlet in a cover of artistic design and execution, has been issued by the Westinghouse Lamp Company to describe and illustrate various types of incandescent lamps of its manufacture. Twenty-six half-tones from refinished photographs, printed on as many pages, show the principal types of lamps, which are described in the opening pages. Information is also given as to the selection of lamps.

ELECTRICAL MEASURING INSTRUMENT.—The Leeds & Northrup Company, of Philadelphia, has issued a third and much-enlarged edition of its catalogue of electrical measuring instruments. The pamphlet, which is 7 ins. by 10 ins. in size, and substantially bound, contains 125 pages of text and illustrations, the latter aggregating more than 100. A considerable number of the instruments have not been previously catalogued, among which are a line of resistance-thermometers, fault-finder, synchronizing and speed-controlling apparatus, alternating-direct-current comparator, bridge for locating faults in power circuits, etc.

Business Notes.

WESTINGHOUSE MOTORS.—Among the orders which the Westinghouse Electric & Manufacturing Company has taken since the first of June are one for 16 locomotives for coal mines in West Virginia and Kentucky, and orders for one for an iron mine in Sweden, another for a power company in the State of Washington, and one for a plate glass mill at Charleroi, Pa.; a complete electric motor equipment for a phosphate mine in Florida; and for a lumber camp at Mount Pleasant, Pa.; an order for 39 motors to drive machinery in a cash register manufacturing plant at Dayton, Ohio; 59 motors for driving textile looms at East Hampton, Mass., and a large number for running spindles in a worsted mill at Passaic, N. J.; 15 motors are going to a paper mill in Canton, N. C., and 20 to a paper mill in Fulton, N. Y.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 9, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

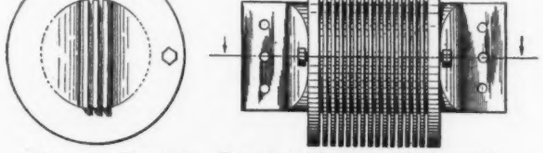
859,200. ELLECTRIC-SWITCH HANDLE; Charles A. Clark, Hartford, Conn. App. filed May 7, 1907. A construction of handle for a rotary snap switch provided with yielding means whereby it may be attached to the switch spindle so as to hold the cover in position without requiring the spindle to be of exact length with relation to the base or frame.

859,201. TELEPHONE SYSTEM; Henry P. Clausen, Chicago, Ill. App. filed July 18, 1903. Complete diagram including cord circuits and ringing connections.

859,219. BLOCK-SIGNAL SYSTEM; Laurence A. Hawkins, Schenectady, N. Y. App. filed Dec. 5, 1906. Relates to block-signal systems for electric roads, in which both rails are made conductive for all currents without inductive bonds or special connections. Has normally open circuited transformers connected across the rails at intervals.

859,221. TELEPHONE SUPPORT; Stephen C. Houghton, Rome, N. Y. App. filed July 10, 1906. Construction of switchbox adapted to contain switches for the local circuits.

859,255. SHUNT FOR ELECTRICAL MEASURING INSTRUMENTS; Frank W. Roller, Plainfield, N. J. App. filed Jan. 13,



859,255.—Shunt for Electrical Measuring Instruments.

1905. A shunt for electric measuring instruments comprising a resistance strip having heat radiators in good thermal relation at distributed points along its surface.

859,276. TELEPHONE SWITCHBOARD; Frank W. Wood, Newport News, Va. App. filed July 12, 1906. The combination with a support, of a shutter hinged thereto, and contacts, operating means therefor, drops and an operator's set mounted upon the shutter.

859,278. SWITCH-CLIP; Gilbert Wright, Pittsfield, Mass. App. filed June 17, 1905. A switch clip comprising abutting plates having offset portions and provided with a threaded opening, a portion of which is formed in each plate.

859,283. POWER CONVERTING AND TRANSMITTING MECHANISM; Patrick J. Collins, Scranton, Pa. App. filed Oct. 12, 1904. The combination with an engine and a driving shaft operatively connected thereto, of a dynamo electric machine comprising an outer member secured to said driving shaft, an intermediate stationary member and an inner rotatable member having a shaft operatively connected to the mechanism which is to be driven and a clutch for connecting said shafts together.

859,292. ELECTRIC LIGHTING; Johannes Harden, Schenectady, N. Y. App. filed Dec. 10, 1903. In combination for use in an alternating-current arc lamp, an electrode containing a predominating amount of titanic material, and an electrode composed principally of carbon.

859,316. SNAP-SWITCH; Walter S. Mayer, Philadelphia, Pa. App. filed April 4, 1907. A snap-switch having various detail features of improvement.

859,318. DYNAMO-ELECTRIC MACHINE; Edgar W. Mix and Paul Bunet, Paris, France. App. filed Nov. 20, 1906. In a multipolar dynamo-electric machine, a parallel-wound drum armature, a field magnet having commutating poles, and means for producing in each pole two magneto-motive forces proportional respectively to the currents flowing through the two adjacent commutator brushes.

859,333. METER; William H. Pratt, Lynn, Mass. App. filed Sept. 25, 1905. A watt-hour meter designed to show the energy consumed in charging a storage battery, and the energy supplied by the battery, and which is so arranged that it will not be influenced by exterior magnetic fields.

859,350. UNIPOLAR GENERATOR; Elihu Thomson, Swampscott, Mass. App. filed Sept. 28, 1905. In a unipolar machine, a pair of collecting brushes independent of the brushes carrying the main armature current connected to the field winding and bearing on a pair of collector rings, connected to opposite ends of a single armature conductor.

859,358. ALTERNATING-CURRENT MOTOR; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Aug. 19, 1905. In an alternating-current motor, a slotted core provided with distributed coils all equal in size, alternate coils being connected in independent sets to form two separate windings of different numbers of poles.

859,359. FREQUENCY-CHANGER; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Aug. 24, 1905. In a frequency changer, two relatively-movable magnetic cores, and two windings of different pole numbers on each core, both windings on one core being connected to the same alternating-current circuit, and one of the windings on the other core being connected to a second alternating-current circuit and the other short-circuited.

859,361. ROTOR FOR HIGH-SPEED DYNAMO-ELECTRIC MACHINES; Bernard A. Behrend, Norwood, Ohio. App. filed Nov. 30, 1906. Covers features of construction of the rotating members of high-speed dynamos, such as the rotary fields of turbo-alternators.

859,363. SECTIONAL GANG-BOX FOR PUSH-BUTTON SWITCHES; Leon W. Bossert, Utica, N. Y. App. filed Feb. 19, 1906. Improvement in multi-sectional gang boxes for rotary or push-button switches. Provides means whereby sections, preferably drawn up from metal, may be assembled together to accommodate varying numbers of switches.

859,367. ELECTRICAL PUSH BUTTON; Frederick W. Cohn, New York, N. Y. App. filed March 5, 1907. Details of construction of a "midget" push button.

859,368. DYNAMO-ELECTRIC MACHINE; Patrick J. Collins, Scranton, Pa. App. filed Nov. 16, 1904. In a dynamo-electric machine, an outer stationary member, an inner rotatable member, an intermediate rotatable member coacting with said inner and outer members, and a mechanical driving connection between said rotatable members.

859,369. DYNAMO-ELECTRIC MACHINE; Patrick J. Collins, Scranton, Pa. App. filed Nov. 30, 1904. The combination with an engine, of a dynamo electric machine comprising an outer stationary member, an intermediate rotatable member having a shaft operatively connected to the engine, an inner rotatable member having a shaft journaled within the shaft of the intermediate member, and a clutch for connecting said shafts together.

859,431. APPARATUS FOR THE ELECTROLYTIC PRODUCTION OF CHEMICAL COMPOUNDS; Courtland F. Carrier, Jr., Elmira, N. Y. App. filed June 9, 1906. Provides an apparatus whereby compounds which require the use of a free metallic element in their preparation by electrolysis may be continuously produced by an economical method.

859,435. SAFETY DEVICE FOR ELECTRIC MOTORS; Frederick M. Conlee, Madison, Wis. App. filed Dec. 9, 1905. The field circuit of the motor has a no-voltage magnet and device controlled thereby for closing the armature circuit.

859,437. PRIMARY BATTERY; William P. Divine and Albert J. Shinn, Philadelphia, Pa. App. filed Aug. 1, 1906. Construction of battery having a plurality of porous tubes and a hollow header connecting and supporting the electrodes.

859,449. TROLLEY-HARP; John Hensley, Huntington, Ind. App. filed Oct. 25, 1906. Provides a trolley-harp having a guard to prevent the trolley wheel from coming down on top of the wire when trying to replace it after it has left the wire.

859,464. ANTI-BUZZING DEVICE FOR TELEPHONES; August Schaffer, East Columbus, Ohio. App. filed Dec. 24, 1906. An anti-buzzing device for telephone receivers comprising essentially in combination, a wire screen, a washer-like device, and a concavo-convex piece, adapted to be placed together and secured in the ear piece of the receiver.

859,473. ELECTRIC SIGNALING SYSTEM AND SELECTIVE MECHANISM THEREFOR; Jean F. Webb, Jr., Chicago, Ill. App. filed Aug. 25, 1906. Details of construction of signaling system, having a selective mechanism designed to signal any desired or selected station from a home or central station. Employs a step-by-step ratchet controlled switch arm at each station.

859,479. GUARD ATTACHMENT FOR TELEPHONES; George L. Blackburn, Greensboro, N. C. App. filed March 7, 1907. Sheet metal device applied to ordinary desk telephone to protect receiver.

859,515. ELECTRIC LIGHTING; William J. Phelps, Detroit, Mich. App. filed July 15, 1903. Covers features of the switch of an incandescent lamp having two separate filaments of different illuminating power.

859,523. MAGNETIC CLUTCH; Lewis D. Rowell, Milwaukee, Wis. App. filed May 1, 1905. Relates to improvements in magnetic clutches in which the driven member may be gradually accelerated and after it has attained full speed the two members positively connected.

859,524. ELECTRICAL CONTACT-FINGER; Henry K. Sandell, Chicago, Ill. App. filed Jan. 21, 1907. Electrical contact finger for self-playing instruments adapted to a perforated sheet and make contact with the metallic roller there-beneath.

859,534. TELEPHONE SELECTING APPARATUS; William D. Watkins, San José, Cal. App. filed April 30, 1906. In selecting signaling apparatus, circuit-closing contacts, an oscillatory selecting member, an electromagnet for actuating the same, and means for guiding the selecting member in a zigzag path into circuit closing position.

859,545. DYNAMO-ELECTRIC MACHINE; Patrick J. Collins, Scranton, Pa. App. filed Dec. 27, 1904. In a dynamo-electric machine, a generator armature, a motor armature, and an intermediate field member wound and arranged to produce a magnetic flux passing in a single path through both armatures.

859,547. SAFETY-FUSE FOR ELECTRIC CIRCUITS; Charles S. Davis, Somerville, Mass. App. filed Oct. 27, 1905. Safety fuse for electric circuits of the cartridge type, in which the fusible wire is enclosed in a casing and surrounded by gas absorbing materials. The caps of the fuse are secured thereon by a bayonet point.

859,551. CUT-OUT SWITCH FOR SERIES-PARALLEL CONTROLLERS; Arthur C. Eastwood, Cleveland, Ohio. App. filed Sept. 27, 1906. Relates to means for cutting out one motor or group of motors operated in series-parallel by means of single operating controller.

859,556. METHOD OF AND APPARATUS FOR FAULT LOCATION ON ELECTRICAL CONDUCTORS; Herbert M. Friendly, Portland, Ore. App. filed April 10, 1905. Electrical testing device intended for locating grounds or crosses on cables or insulators. Form of Wheatstone bridge.

859,565. APPARATUS FOR DETINNING TIN-SCRAP; Meredith Leitch, Elizabeth, N. J. App. filed Feb. 17, 1906. Has a tubular U-shaped basket through which a conveyor passes and a tank adapted to contain a liquid for treating the contents of said basket.

859,566. METHOD OF DETINNING TIN-SCRAP; Meredith Leitch, Elizabeth, N. J. App. filed Feb. 17, 1906. Relates to the method of the above patent.

859,578. ELECTRIC SOLDERING TOOL; Nicholas Porrella, New York, N. Y. App. filed Feb. 20, 1906. Provides a soldering tool in which the heating coil is disposed within the soldering head so as to be protected against corrosion and oxidation, and in which the tool may be heated to either of two degrees of heat.

859,579. ARC-LIGHT ELECTRODE; Robert H. Read, Schenectady, N. Y. App. filed May 18, 1901. An arc-light electrode containing carbid of aluminum.

859,703.—Insulating Strain.

859,598. ELECTRIC SIGNALING AND TESTING MECHANISM; John Doran, Jr., Schenectady, N. Y. App. filed June 28, 1906. Covers signaling and testing mechanism for use in an open circuit electric signaling and testing system having a rectifying electrolytic cell incorporated in the circuit.

859,608. ELECTRIC RESISTANCE ELEMENT; Albert L. Marsh, Lake Bluff, Ill. App. filed Feb. 18, 1907. An electric resistance element composed of an alloy consisting of metal having the properties of nickel and cobalt; and a relatively small proportion of aluminum.

859,620. ELECTRICAL SELF-PLAYING INSTRUMENT; Henry K. Sandell, Chicago, Ill. App. filed Feb. 5, 1906. An electrical xylophone.

859,621. CIRCUIT CHANGER; Edmund O. Schweitzer and Alfred Herz, Chicago, Ill. App. filed Sept. 14, 1904. Has a spring actuated switch and a thermal actuated device included in the circuit and adapted to be operated by the passage of an excess current through it, and movable into and out of the path of travel of said switch to hold and release the same.

859,641. ELECTRIC FURNACE; Edward A. Colby, Newark, N. J. App. filed Nov. 23, 1905. Construction of induction furnace having a refrigerating circulation system.

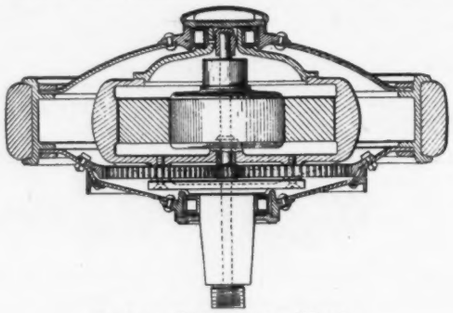
859,667. AUTOMATIC TROLLEY-GUARD; Henry A. Kenned, Natick, R. I. App. filed Jan. 29, 1907. Construction of trolley wheel having a perforated yieldingly supported revoluble and endwise movable guard flange.

859,674. MASSAGE APPARATUS; Carl O. Lindstrom, Chicago, Ill. App. filed May 26, 1906. Vibratory massage apparatus designed to be driven by a motor and in which the force or range of the vibration can be changed as required.

859,703. INSULATING-STRAIN; Louis Steinberger, New York, N. Y. App. filed May 1, 1906. Construction of strain insulator having circumferential ribs to prevent creepage currents in wet weather.

859,731. ELECTRICAL CONDENSER; Sidney A. Reyland, Elyria, Ohio. App. filed Jan. 10, 1907. A combined contact and securing bolt by means of which a telephone condenser can be held upon a suitable rack.

859,753. PROCESS FOR THE BUILDING UP OF SPONGY LEAD PLATES FOR ELECTRIC STORAGE BATTERIES; Julius Diamant, Gyor, Austria-Hungary. App. filed Nov. 28, 1906. The process of building up spongy lead plates for electric storage batteries which consists in dividing the plates into sections and then varying the relative order of the sections to bring the internal surfaces to the outside and the deteriorated surface to the inside.



859,820.—Elecric Motor Wheel.

859,774. TWO-WIRE MULTIPLE TELEPHONE SYSTEM; Jacob W. Lattig, West Bethlehem, and Charles L. Goodrum, Philadelphia, Pa. App. filed June 6, 1903. Complete diagram of circuits for multiple exchange system including phantom line circuit.

859,783. TROLLEY-FINDER; Frederick A. Selley, Nashville, Tenn. App. filed July 26, 1906. Has a pair of pivoted fingers pivoted to the trolley harp and gear connections for moving them upwardly so as to keep the wheel on the wire.

859,792. DETINNING; Raymond S. Wile, Pittsburg, Pa. App. filed Oct. 19, 1906. The process of detinning which consists in dissolving the tin in a solution and subjecting such solution to the action of a current of sufficient voltage to cause the separation of the tin, said solution consisting of stannic chloride having hydrochloric acid added thereto.

859,816. LIQUID-FLOW ALARM; Raymond S. Kelsch, Montreal, Quebec, Canada. App. filed May 3, 1907. Provides means whereby a cup rising and falling within a casing will sound a suitable alarm at the limit of its movement.

859,820. ELECTRIC MOTOR-WHEEL; Karsten Knudsen, Grand Rapids, Mich. App. filed Oct. 4, 1906. Has a driving shaft mounted coaxially with respect to the driven member, a pinion thereon, gearing between opposite sides of the pinion and opposite sides of the driven member and equalizing means.

859,821. CONTROLLER FOR INCANDESCENT ELECTRIC-LIGHT BULBS; Theodore Kopp, Philadelphia, Pa. App. filed Oct. 13, 1906. An electric light controller provided with contact arms and a short circuit pin, said contact arms and short circuit pin being normally held out of engagement, a resistance coil and connections for making contact between said arms and between said arms and pin.

859,826. VARIABLE-SPEED MOTOR; George Martinka, Jersey City, N. J. App. filed July 17, 1906. Relates to electrical generators and is designed to produce an easy adjustment of the variable speed necessary on such motors as are usually employed in direct-connected electrically driven machinery.

859,827. HYGIENIC TELEPHONE APPLIANCE; Charles H. Molyneux and Max Braunstein, Rochester, N. Y. App. filed Sept. 12, 1906. A device of the character described comprising an upper casing having a stationary shaft to support a rolled strip of material and a door, a lower casing comprising relatively fixed and movable sections and a hinged door, a winding shaft carried by said door, and means for preventing retrograde movement of said shaft.

859,840. ELECTRIC LIGHT ILLUMINANT; Robert H. Read, Schenectady, N. Y. App. filed Sept. 16, 1904. An arc-light electrode containing magnesium carbid.

859,867. TROLLEY; Charles A. Bluhm, Michigan City, Ind. App. filed Feb. 27, 1906. Contact shoe for threaded shells having a roller on a short pivoted arm which can be raised off the rail by a rod or wire connection.

859,868. THIRD RAIL; Charles A. Bluhm, Michigan City, Ind. App. filed Feb. 27, 1906. Construction of third rail in which the flow of current to the collector shoe will not be interrupted at crossings, etc.

859,872. RAILWAY BLOCK-SIGNAL SYSTEM; Winthrop M. Chapman, Newton, Mass. App. filed Feb. 4, 1903. Covers complete detail features including lamps and solenoid mechanism for moving the semaphore arms.

859,884. TELEPHONE SERVICE APPARATUS; Uriah S. Jackson, Ossipee, N. H. App. filed Aug. 18, 1905. Two-party line subscribers' instrument.

859,889. ARC-LIGHT ELECTRODE; Robert H. Read, Schenectady, N. Y. App. filed Oct. 10, 1902. An arc-light electrode formed of carbid of titanium.

859,890. ARC-LIGHT ELECTRODE; Robert H. Read, Schenectady, N. Y. App. filed Oct. 25, 1902. Carbid electrode with waterproof cover.

859,891. ARC-LIGHT ELECTRODE; Robert H. Read, Schenectady, N. Y. App. filed May 29, 1905. An arc electrode consisting of zirconium carbid admixed with a suitable binding material.